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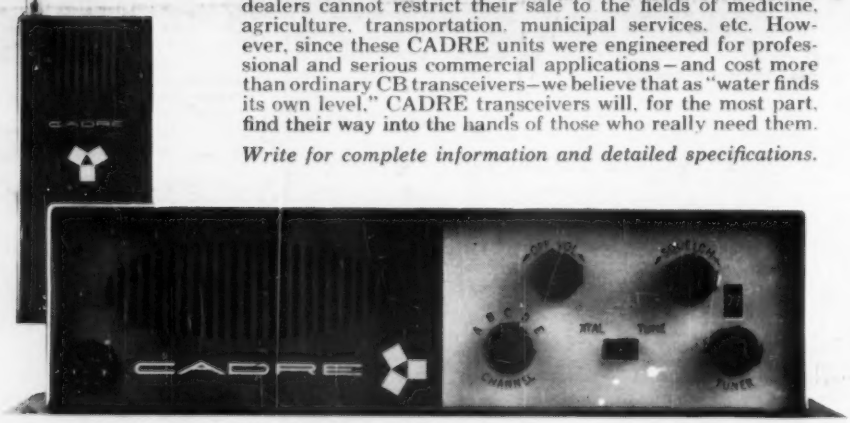

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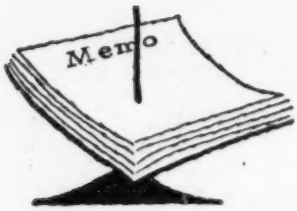

Notes from the Editor

1961--SOME RANDOM PROGNOSTICATIONS

CITIZENS BAND. Activity will reach the saturation point in the urban areas by September/October .... The 5-watt input level will not be raised to 10 or 25 watts .... At least two manufacturers will offer a single-sideband transceiver claiming that SSB can double the number of available CB channels .... Crystals for "Receive" channels will be eliminated and replaced by push-button tuning .... CB transceivers will incorporate "spotting" switches which use the transmitter crystal to set tunable receiver dial calibration.

STEREO AND HIGH FIDELITY. Three-speaker stereo (derived from two channels) will gain widespread acceptance among those "in the know" ....Reverberation techniques will be improved, but will still remain in the gimmick category .... More FM tuners and receivers will be sold in 1961 than in any other year in the history of FM .... At least one manufacturer will offer a "flexible" speaker enclosure for the home owner who wants to build a system into the walls of his home .... Another manufacturer will stress multiple small speakers for good bass response as opposed to one big speaker.

EXPERIMENTERS AND HOBBYISTS. Tunnel diodes will drop in price and find their way into many home-built projects .... Infrared will attract a lot of interest and will be found in fire and burglar alarms.... There will be a spurt of interest in R/C model control supported by new transistorized circuits, higher transmitter power and better antennas. Long dormant, model control looks like a hot subject in 1961/62 .... G.E.'s "Compactrons," off to a shaky start, will prove that vacuum tubes are <u>not</u> on their way out.

HAM RADIO. There will be a quarter of a million hams by December .... Sunspots will decline and cause a mass exodus from the 10-meter band .... The interest in SSB will continue unabated .... Six meters will become increasingly popular as a "mobile" band, and greater use will be made of the top end of the band .... More manufacturers will follow the trend toward decreasing the cost of ham equipment by offering it in partially assembled kits.

SHORT-WAVE LISTENING. DX on the 25-, 31- and 41-meter bands will be dominant during the late fall and early winter .... The British plan <u>not</u> to report stations operated by the Communists will gain favor--especially stations in those countries that operate jamming transmitters .... In the fall of 1961 one manufacturer will offer SWL's receivers with a special bandspread dial calibrated for the 16-, 19-, 25-, 31- and 49-meter bands.

All-in-all, we think 1961 is going to be pretty interesting.

Oliver P. Ferrell

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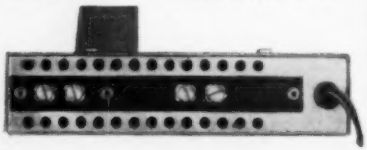

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FCC Report

By ROBERT E. TALL
Washington Correspondent

CB License Problems

THE FCC is upset about statements that have appeared in reputable magazines concerning the supposed "legal" use of unlicensed radio equipment (under Part 15 of the Rules) with CB units. Such statements can cause trouble for people who do not understand the CB Rules and who try to persuade other people to use "unlicensed" equipment for improper purposes.

To set the record straight, if you are licensed in the Class D citizens radio service, *do not* communicate with any station which is not licensed for Class D service. If you are licensed and you do communicate with such stations, the penalties accrue to you and not to the man with the unlicensed equipment.

Some Part 15 equipment can be operated on either a licensed or unlicensed basis. But your Part 15 transceiver must be licensed if you want to communicate with stations that are licensed under Part 19 of the Class D rules. If you have a 100-milliwatt Part 15 transceiver, be sure it meets the minimum CB equipment specifications given in Section 19.51 of the FCC Rules and Regulations.

For the first time since the CB service became a "formality," the FCC has formally expressed its policy on club licensing, and says that it presents a "distinct problem."

The agency has indicated that it realizes CB clubs are "capable of playing an important and useful part in the self-regulation of the service, when they function to promote equitable solution of mutual interference problems." But the FCC feels it is "difficult to visualize" the *need* for a radio club to hold a station license. Presumably, the agency says,

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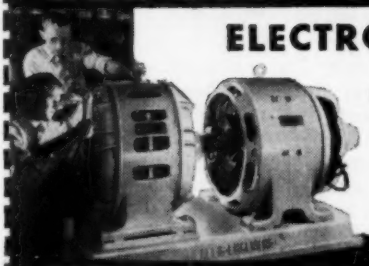

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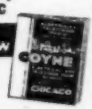

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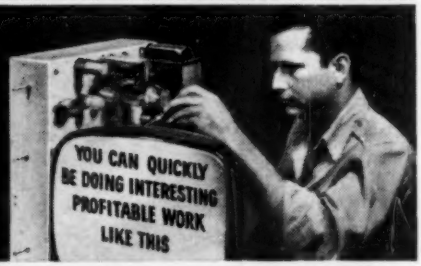

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each club member holds a CB license in his own name and, if the Rules are complied with, "any proper substantive messages could be transmitted over individually owned and licensed stations of the club members."

The FCC has further stated that it will not countenance the use of a club station as a subterfuge to avoid the five-minute limitation contained in its Rules on intercommunications between units of different stations. With the unexpected volume of citizens radio business that the FCC has on its hands, it's not difficult to appreciate the agency's attitude.

Citizens Band clubs, the Commission says, "often appear to be very loosely held together with little or no control or supervision of the related activities of their individual members." And "serious questions may be raised as to whether adequate control and supervision of the individual radio units can be maintained at all times by the licensee, as required by Section 19.92 of the Rules." Such control, the agency cautions, "must be sufficient to prevent the use of the radio station as a hobby in itself," and must insure that all communications transmitted are in compliance with Section 19.61 of the Rules.

Many private groups organized for emergency or civil defense purposes are also applying for CB licenses. When such groups are actual auxiliaries of civil defense or law enforcement agencies, the governmental agency involved has to indicate its sponsorship and approval of the group if the station license is to be granted. If the group is not officially sponsored and approved, it will be considered as simply another type of club.

The FCC wants club members and officers to "note particularly the provisions of Section 19.12 of the Rules, which specify that not more than one person shall be eligible as a licensee of the same transmitting equipment." Since by definition most organizations are "legal persons," the Commission feels that "individually owned and licensed equipment may not be also operated under a club or other organization license without actual transfer of ownership and control of the equipment in each case." -30-

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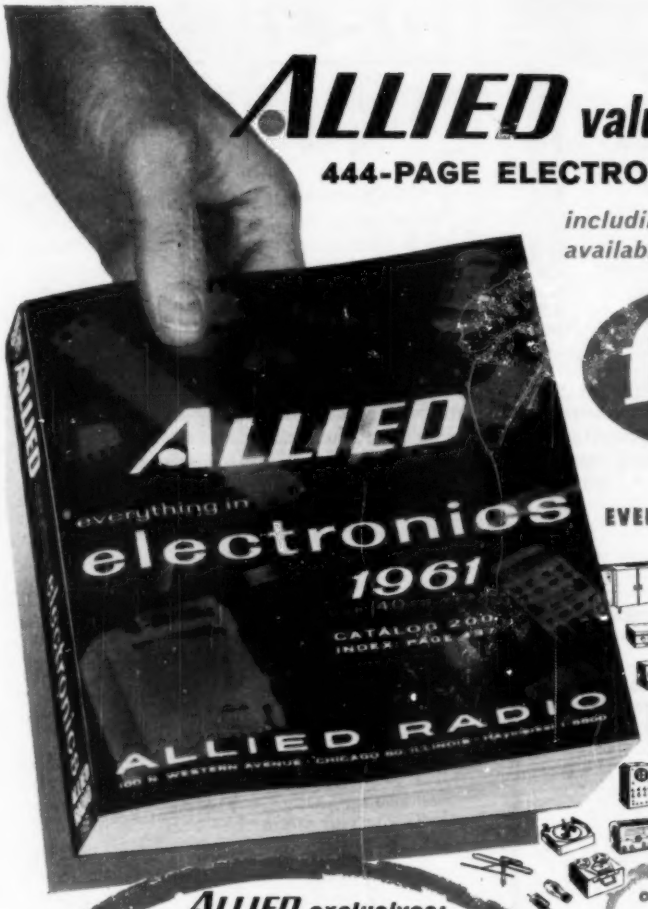

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Hi-Fi Showcase

A GOOD many hi-fi manufacturers are swinging into the new year with some truly noteworthy new products. Space doesn't permit mentioning all of them, but a trip to your local dealer will soon convince you that things are really jumping in hi-fi. For more information on any of the products mentioned here, write directly to the manufacturers (see addresses at the end of this column).

Acro Products, long famous for its output transformers, has put two of these transformers in its new Stereo 120 amplifier. A brute of a unit (it weighs 47 pounds), the Stereo 120 puts out 60 watts in stereo, 120 watts in monaural—enough to make even the most inefficient speaker system sit up and take notice. It makes use of the famous Ultra Linear circuit, which Acro's president, Herb Keroes, patented some years back. The output tubes are EL-34's, but it's a simple matter to substitute KT-88's or 6550's if you prefer the British or American equivalents to the Dutch. Price of the Stereo 120: $159.50 for the kit, $219.50 for the factory-wired model. . . . . If you haven't been keeping up with developments in the arm-and-cartridge area, you may be surprised to learn that tracking pressures of a gram and less aren't unusual these days. ***Audio Dynamics'*** new stereo cartridge, for example, reduces record wear to just about the vanishing point with a tracking force of 0.75 to 1.5 grams in top-grade arms. The ADC-1 is a cinch to mount, since it will fit in almost any arm, regardless of mounting centers, and its four pin connectors can be used with either 3- or 4-wire leads. The cartridge sells for $49.50, with replacement styli priced at $25.00 each.

Simultaneous Bach and bop don't sound very enticing. But divided, and fed into separate rooms, they can be mighty nice—especially when you need only one major piece of equipment for the whole setup. The keystone for such an arrangement is ***Bogen-Presto's*** new 40-watt FM/AM stereo/mono sound cen-

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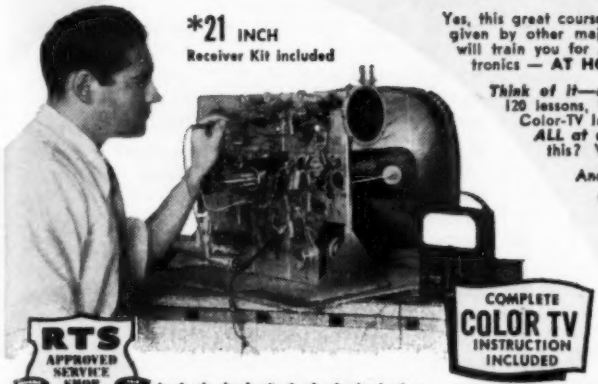

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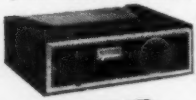

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Showcase

(*Continued from page* 12)

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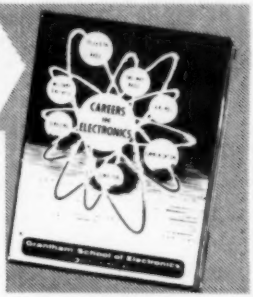

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Showcase

(*Continued from page* 14)

specifically for stereo sound, the LH-190's tubular styling makes it right at home in almost any room, regardless of decor. Measuring 10″ in diameter and standing 24½″ high, the LH-190 handles 15 watts over a frequency range of 35 to 18,000 cycles, and sells for $85.00. . . . . Flipping from mono to stereo is sometimes pretty complicated, and so is switching from a standard spindle hole to the big cutouts in 45-rpm discs. ***Lesa***'s new SM5-DU2 stereo/mono manual player solves both problems with a quick-flip switch on top of the pickup and a 45-rpm spindle built right in the turntable. Price is $29.95. . . . . ***Pickering***'s new 381 stereo cartridge, once sold only for lab use, is now available for home hi-fi systems. A professional cartridge originally designed for making precise record measurements, the 381 is produced in both high- and low-impedance models, is flat within 2 db from 20 to 17,000 cycles, and has a tracking force in professional arms of 2 to 3 grams. All units are furnished with an individual calibration test report; prices are $48 to $60, depending on styli.

Featuring an exclusive silver-plated "front end," ***H. H. Scott***'s Model 310D FM tuner also incorporates an interstation noise suppressor claimed to be the quietest and fastest-acting ever offered to music listeners. If you already own other Scott equipment, you'll be happy to learn that chassis styling on this sensitive, wide-band tuner exactly matches that of a good many Scott amplifiers and preamps. Price of the tuner alone, less case, is $184.95. A matching metal case is available for $12.95, and a wooden case sells for $19.95 in a choice of mahogany, limed oak, or oiled walnut finishes. -30-

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Bogen-Presto Div., Siegler Corp., P.O. Box 500, Paramus, N. J.
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Electrophone & Parts Corp. (Lesa), 530 Canal St., New York 13, N. Y.
Heath Co., Benton Harbor, Mich.
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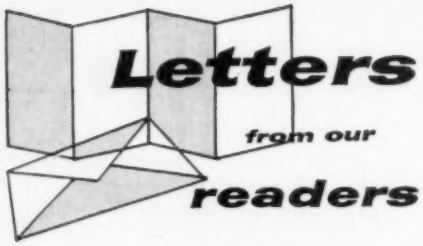

Words of Advice on BCB DX

■ Glen Kippel's article on broadcast-band DX (September issue, page 60) brought back many happy memories of the days when I used to be an active DX'er. The BCB DX'er has a hard row to hoe before he can realize the thrill of receiving veries from distant stations—much harder than his fellow listener on the short-wave bands. Maybe these few words of advice from an old-timer will help.

Don't "cruise" the bands; instead, have a definite objective in mind. Monitor either a certain band, or one particular geographic area, or even a special station. Experiment with different antennas—a long-wire isn't always best for all stations and all directions. A vertical antenna sometimes works wonders.

Monitor "twilight skip" by observing the fading pattern of a station above 1000 kc. at a distance of 40 to 60 miles. If the station exhibits an unusual amount of fading and distortion, you can be sure that good 3000-4000 mile skip is forming. I have logged many Cuban and Central American stations this way.

If you are plagued with what seems to be an all-night disc jockey, write the station and ask when they are off the air. Set your alarm for that time, and behold—a silent channel, probably full

of DX. I did this with WSM in Nashville, Tenn., and received a prompt and courteous reply with the information requested. One night when WSM went off for a few hours I logged a New Zealand station.

CHARLES C. BOEHNKE
Reno, Nevada

BCB DX'er Boehnke did most of his listening after World War II from a QTH in Southern California and was a member of the Victory Radio Club.

"Min-O-Scope" Suggestions

■ The Min-O-Scope, in your August 1960 issue, appears to be a very nice piece of equipment, but I would like to make a couple of suggestions. Wouldn't it be possible to increase the vertical frequency response with peaking coils? They are quite inexpensive and one placed between R_3 and B+ should do the trick.

Wouldn't it also be possible to add a horizontal input to the scope by making S_2 (which was labeled S_1 on the diagram, incidentally) a 6-position instead of a 5-position switch? When the switch was in the sixth position (V_2's grid not connected to any of the frequency-determining capacitors), an input signal could be fed through a suitable blocking capacitor to the high end of R_{19}. The tube (V_2) should then function as an amplifier. This input could be used when you wanted to show a Lissajous figure or something of that nature.

HORACE D. SMITH
Baytown, Texas

Reader Smith's suggestion about peaking coils seems sensible, but the coils would have to be carefully selected and the amplifier gain checked for linearity. As far as adding a horizontal input is concerned, it should work, but may require some experimenting.

Equipment Conversion

■ I have access to surplus electronic equipment—miniature motors and other devices—which, unfortunately, operates only on 24- to 28-volt, 400-

cycle a.c. Can you or any of your readers suggest a simple way to convert to this frequency from 117-volt house current?

DR. F. A. LEMOINE
113 Girard Blvd., S.E.
Albuquerque, N. Mex.

If anyone has any ideas on this subject, please write directly to Dr. Lemoine.

Versatile FM Tuner

■ Congratulations to Robert E. Devine on his fine construction article in your August issue (page 49). The "One-Tube FM Tuner" works better than I ever expected it to, and I can get stations from Buffalo, N. Y., 50 miles away. A friend of mine, who also built one, receives police calls, fire department calls, etc., by adjusting coil L_2. This was a very rewarding project, and it didn't hurt my pocketbook.

JERRY WALD
Toronto, Ont., Canada

Annoyed Listener

■ I have had many a pleasant day at the beach or in the country spoiled by someone else's transistor portable radio playing with the volume turned up full. Some people don't seem to realize that there are others who prefer the peace and quiet of the country. Can you furnish me with a circuit for a pocket-sized noise generator or tunable oscillator that will blot out one or more stations on the

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- For the Ham
- For the Retailer

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Letters

(*Continued from page* 18)

broadcast band? It should be transistorized and have a range of about 20 feet.

ROBERT D. FREED
New York, N. Y.

Intentionally causing interference in the manner you describe is a violation of the FCC Rules, punishable by imprisonment and/or fine. Why not try to find a quieter spot to spend the day?

Computer Articles in Demand

■ I just finished reading "Russian-English Translating Machine" in the August 1960 issue. Congratulations to Ken Gilmore for his fine interpretation of "How the Translator Works." I've been a P.E. reader since 1955 and particularly enjoy your articles on computers. How about some more of them?

ROBERT G. HEIM
Albert Lea, Minn.

We have a computer article in the works now, which is scheduled to appear in an upcoming issue. Watch for it.

The Good Earth

■ We read your article, "Communicating Through the Earth," by J. C. Fischesser, (July 1960 issue), and we decided to try it. It works very well.

We use tape recorders as the amplifiers—they make a very neat-looking station. By using tape recorders, we can prerecord tapes and play them into the system. Our power runs from .8 to 3.5 watts. We found that 2000-ohm headphones work best in our area.

Our call letters are GTS-71, 72, and 73. The letters stand for Ground Travel Station. The 7

stands for the amateur call district, and the 1, 2, and 3 for the number of the station.

ROBERT FUNK, KN7KZF,
DENNIS HEIDENREICH,
DOUG MOORE
Scottsdale, Arizona

Low-Frequency DX

■ The frequency listed for Thule, Greenland, in Tom Kneitel's "DX'ing Down Below" (July, 1960, p. 51) has been changed. Station XPM50 now operates on 77.15 kc., instead of 98.5 kc. Also, the audio modulation that used to appear on the carrier has been deleted.

M/SGT. ALLEN M. RAYMOND
1933-2 AACS Squadron
APO 864, New York

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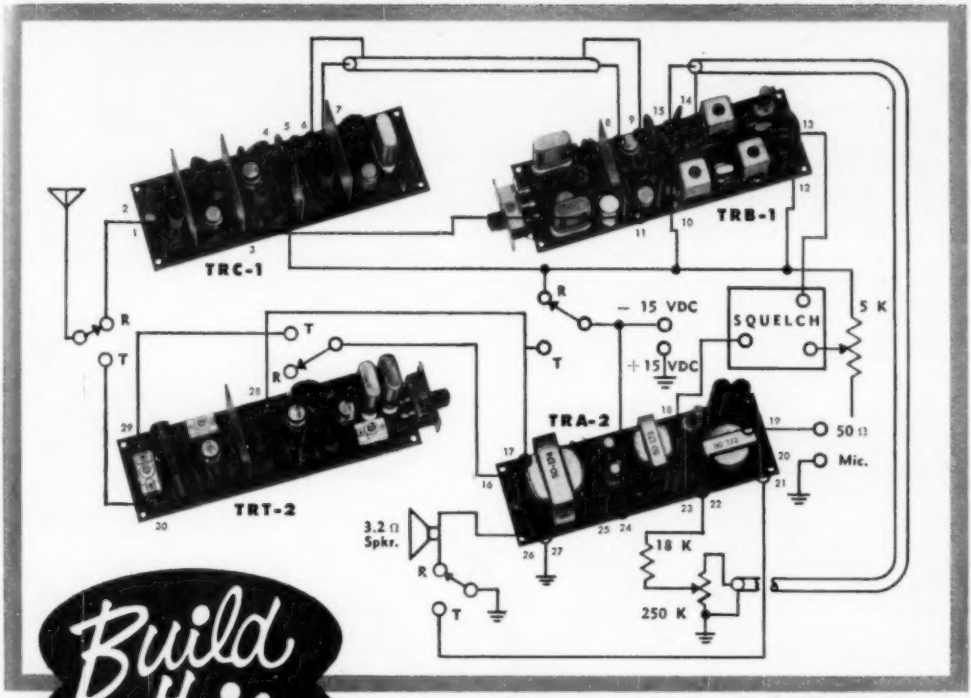

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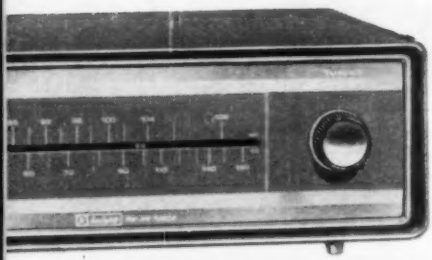

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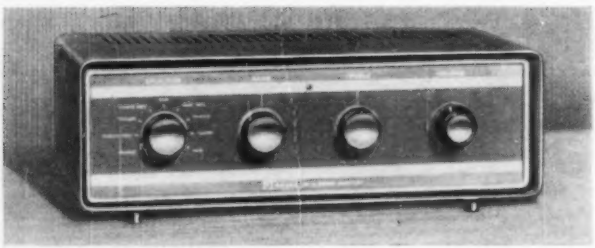

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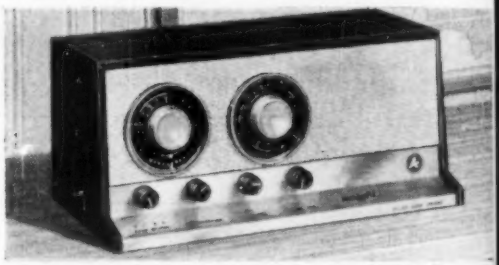

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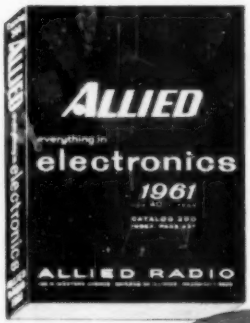

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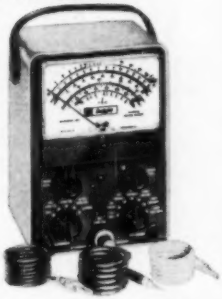

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Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
OZ4	.42	1AF4	.88	5Y3	.49	7A4/XXL	.44	12AU6	.42
1A7GT	.42	1BC3	.48	5U4G	.49	7A5	.42	12AT7	.61
1B3GT	.42	1BN6	.48	5U8	.59	7A6	.42	12AT6	.52
1H4G	.52	1BZ6	.80	5V4G	.49	7A7	.44	12AV6	.42
1H5GT	.39	1CB6	.60	5V6GT	.49	7A8	.42	12AX4	.46
1L4	.45	1CF6	.41	5X8	.45	12A6	.46	12AX7	.61
1L6	.59	1C5G	.42	5Y3GT	.45	12AQ5	.42	12BA6	.42
1N5GT	.42	1LF4	.42	5Y4G	.42	12AT6	.52	12BE6	.42
1Q5GT	.52	3A4	.49	6A7	.52	12AT7	.52	12BH7	.61
1R5	.44	3B4	.44	6A8	.60	12AU6	.42	12BY7	.61
1S5	.41	3V4	.44	6AB4	.60	14A7/12BY7	.61	35/51	.40
1T4	.39	4BC8	.44	6AC7	.60	14BG	.48	35A5	.52
1U4	.41	4BZ7A	.65	6AF4	.55	14Q7	.48	35B5	.45
1U5	.41	5AS8	.65	6AG5	.52	19	.48	35C5	.44
1V2	.42	5AT8	.52	6AG7	.40	19AU4GT	.48	35L6GT	.46
1X2	.49	5AV8	.44	6AH4GT	.44	24A	.49	35W4	.45
2A3	.52	5AW4	.44	6AH6	.65	25A5	.48	37	.43
2X2	.95	5BK7	.49	6AK5	.42	25B6G	.75	39/44	.48
		5R8	.58	6AL7	.42	25BQ6	.79	41	.52
			.51	6AM8	.45	25Z5	.75	42	.45
					.49	25Z6	.79	43	.45
						25Y5	.99	45	.45
						25Z6	.99	50C5	.60
						50L6GT	.48	50A5	.47
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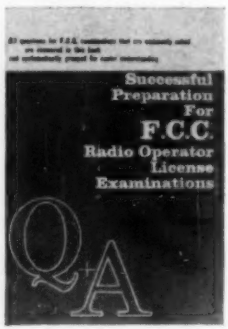
"SMITHSONIAN TREASURY OF SCIENCE," edited by Webster P. True. Published by Simon and Schuster, Inc., 630 Fifth Ave., New York 20, N. Y., in cooperation with the Smithsonian Institution, Washington, D. C. Three volumes, 1208 pages. Hard covers. $15.00.

A veritable library of science, this three-volume set contains articles covering almost every field of scientific knowledge and research written by some of the world's foremost authorities. Subjects include astronomy, physics, oceanography, meteorology, engineering, and exploration; authors include W. C. Roentgen ("The X-Rays"), G. Marconi ("Wireless Telegraphy"), J. Edgar Hoover ("Physical Science in the Crime-Detection Laboratory"), and Albert Einstein ("Isaac Newton"). Furnished with an attractive cardboard binder, the set contains 133 full-page photographic plates and 120 text illustrations, including maps, drawings, and woodcuts.

"SUCCESSFUL PREPARATION FOR F.C.C. RADIO OPERATOR LICENSE EXAMINATIONS," by Darrell L. Geiger. Published by Prentice-Hall, Inc., Englewood Cliffs, N.J. Hard cover. 689 pages. $9.25.



To operate, maintain, or service any commercial radio transmitter in the United States requires some form of FCC license. There are several classes of licenses available, some easier to get than others but carrying fewer privileges. This book describes the various licenses, the nature of the examinations which have to be taken to obtain them, and how to pre-

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Bookshelf

(*Continued from page* 24)

pare for the exams. Broad answers to hundreds of typical questions are given which, if studied carefully, will enable the reader to answer any actual exam questions on the same topic correctly. A must for the man seeking a commercial license.

"S-9 SIGNALS" by William I. Orr. Published by Radio Publications, Inc., Wilton, Conn. Soft cover. 48 pages. $1.00.

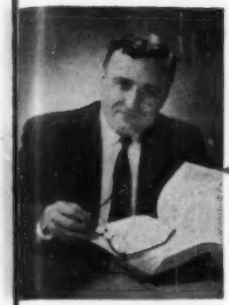
This latest volume from the pen of the prolific Mr. Orr is one of the most practical paperbacks we've seen in a long time. Although only 48 pages big, it overwhelms the reader with plans for 11 antennas—the likes of which we've *never* seen. Inexpensive to build and simple to install, they undoubtedly can give S-9 signal results simply because Bill Orr believes in proper matching. Recommended for SWL's and hams operating from 2 to 80 meters.

"AUTO RADIO SERVICE MANUAL, Volume 10" published by Howard W. Sams & Co., Inc., 1720 East 38th St., Indianapolis 6, Ind. 160 pages. Soft cover. $2.95.

Still another volume in the Sams "PHOTOFACT" series covers 31 auto radios produced in 1958 and 1959 under the following brand names: American Motors, Automatic, Buick, Cadillac, Chevrolet, Edsel, Ford, Gonset, International, Mopar, Motorola, Oldsmobile, Pontiac, Riverside, and Vauxhall. It should be a very valuable reference work for the service technician who specializes in auto radio repair.

"MAGNETIC AMPLIFIERS—PRINCIPLES AND APPLICATIONS," by Paul Mali. Published by John F. Rider Publisher, Inc., 116 West 14th St., New York 11, N. Y. 112 pages. Soft cover. $2.45.

The increasing use of magnetic amplifiers makes this book both timely and practical. Presuming a fundamental knowledge of electricity, it starts with a



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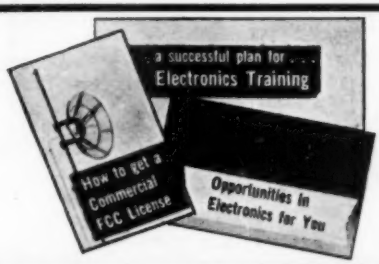

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PE 73

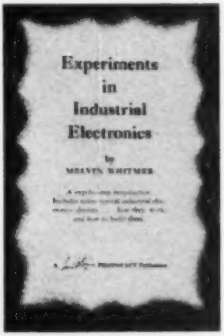
Bookshelf

(*Continued from page* 26)

basic review of magnetism, electromagnetism, and magnetic circuitry, then goes into saturable reactor theory—the key to this field. Gain and feedback in magnetic amplifiers is covered, as well as construction and general uses, maintenance, and trouble-shooting.

"EXPERIMENTS IN INDUSTRIAL ELECTRONICS," by Melvin Whitmer. Published by Howard W. Sams & Co., Inc., 1720 East 38th St., Indianapolis 6, Ind. Soft cover. 94 pages. $1.95.

Experience in entertainment phases of electronics is not enough to allow someone to step into the field of industrial electronics servicing—he needs actual bench experience on industrial equipment. This book is intended to provide such experience through the construction of several projects representative of industrial gear. Diagrams and step-by-step instructions are included for building a photo-electric alarm, an r.f. heating system, an electronic timer, a proximity detector, etc. For those not interested in a career in this field, the book can serve as a source of unusual projects.

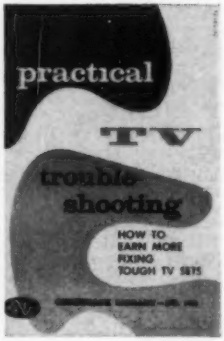


"PRACTICAL RADIO AND ELECTRONICS COURSE FOR HOME STUDY," prepared under the direction of M. N. Beitman. Published by Supreme Publications, 1760 Balsam Rd., Highland Park, Ill. Soft cover. 216 pages. $3.95.

In this book, the beginner in radio and electronics is introduced to the components that make up the ordinary household receiver. Following an explanation of common electronic construction practices, the book advances through meters, circuit properties, test instruments, receivers, transmitters, and non-entertainment (industrial) equipment. It should provide the uninitiated with a basic understanding of a broad field.

"PRACTICAL TV TROUBLE-SHOOTING," published by Gernsback Library, Inc., 154 West 14th St., New York 11, N.Y. Soft cover. 128 pages. $2.35.

Here is a collection of outstanding service articles by many well-known technician-writers. Intermittents, video i.f. oscillation, horizontal jitter, ghosts, and picture quality control are among the subjects covered. As the title suggests, the emphasis is on the practical side of servicing, but some theory is included (apparently on the assumption that "you can't fix 'em properly if you don't understand 'em"). Recommended for beginners and experienced technicians alike.



Free Literature

Two additions to the regular Heath line of amateur radio, hi-fi, marine, and test equipment kits are featured in the Heathkit Fall & Winter 1960-61 catalog. A new "Science Series," aimed at introducing youngsters to electronics, includes three simple electronic workshop hookups, as well as radios, an intercom, a code practice set, and a portable transmitter. And for the first time in its history, the company has some of its equipment available in factory-wired and tested form. Write to the Heath Company, Benton Harbor, Mich., for your copy.

A six-page folder—"Recommended Circuits for Transistorized Radios"—can be obtained by writing Tung-Sol Electric, Inc., 95 Eighth Ave., Newark 4, N. J. Four circuits are given, covering units which incorporate from four to seven transistors. -30-

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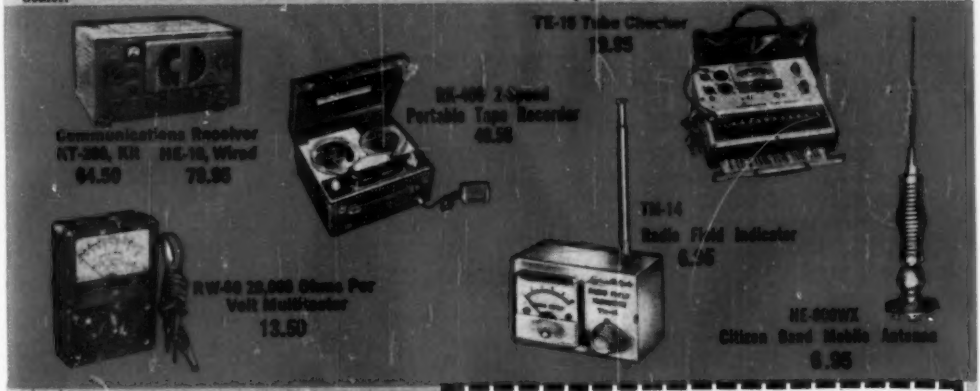

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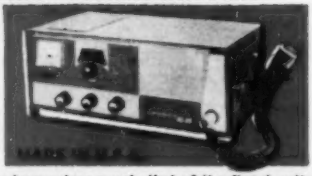

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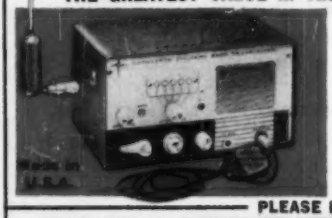

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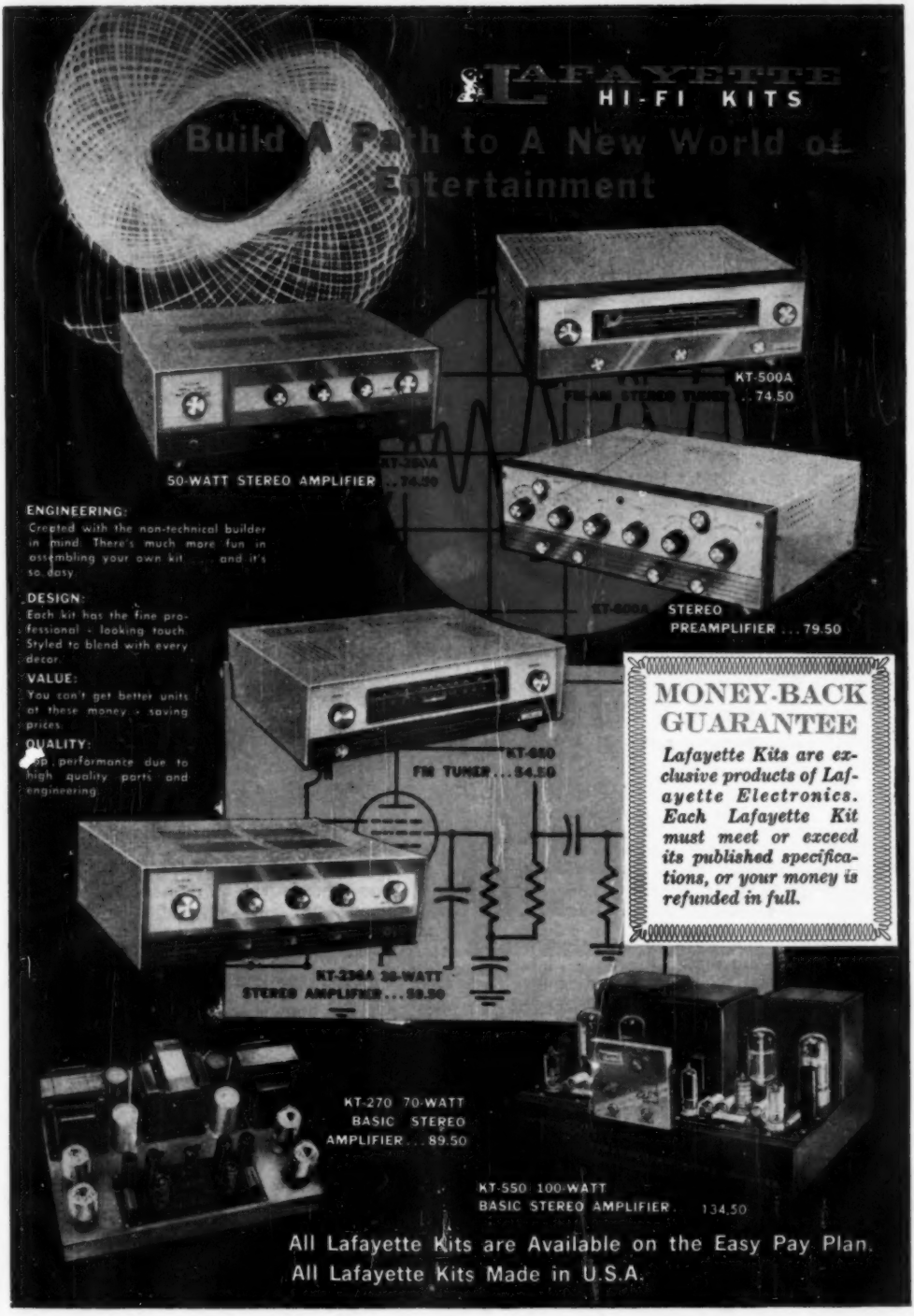
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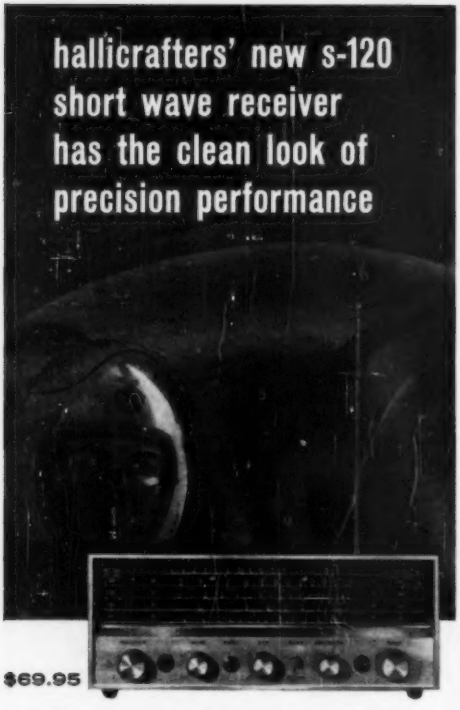

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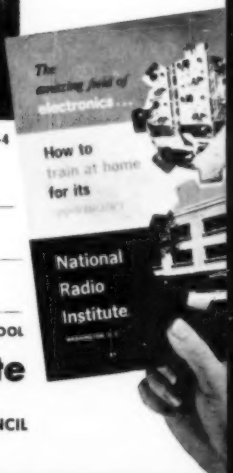

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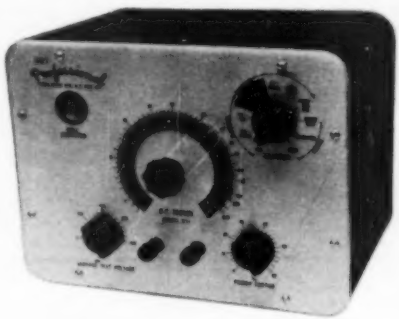
products

(*Continued from page* 32)

viders and adhesive labels, permitting its further use after the capacitor supply is exhausted.

R-C TESTER

The latest addition to the NRI "Professional" line of test instruments is the Model 311 resistor-capacitor tester. A bridge circuit is used for accurate measurement of resistance, capacitance, leakage, power factor, opens, and shorts. Four capacitance and four resistance



ranges cover from 0.00001 to 1500 μf. and from 1 ohm to 150 megohms; 1% precision resistors, 5% capacitors, and a 6E5 null indicator insure accuracy. Price: $28.75, wired; $19.75 as a kit. (*National Radio Institute,* 3939 Wisconsin Ave., Washington 16, D. C.)

CERAMIC MICROPHONE

A high-output ceramic microphone available in two models (MK-3 and MK-3L) has been announced by *CBS Electronics,* 100 Endicott St., Danvers, Mass. Frequency response of the MK-3 is 30 to 10,000 cycles. Output is -52 db and the recommended load resistance is 5 megohms. The MK-3L is similar to the MK-3, but is mounted on a 13½" gooseneck that makes it suitable for use in paging systems and language laboratories. Other variations with a push-to-talk button can be had for mobile and CB use.

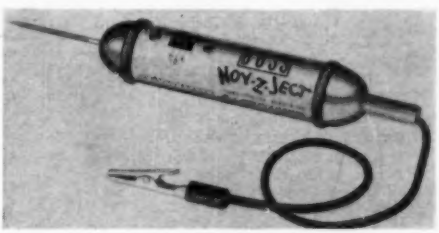
C.W. TRANSMITTER

Designed for the novice, and for the advanced ham who wants a low-power (60 watts) standby rig, the EICO 723 transmitter is available either wired or as a kit. It covers 80, 40, 20, 15, and 10 meters with single-knob bandswitching. The meter may be switched from the

final's plate to its grid circuit. With an external modulator, the unit can put out an AM phone signal. Other features include: a built-in antenna relay, VFO power take-off, modulator/accessory socket, and effective TVI suppression. Price: $49.95, kit; $79.95, wired. (*Electronic Instrument Co., Inc.,* 33-00 Northern Blvd., L. I. C. 1, N. Y.)

SIGNAL-INJECTION PROBE

The "Noy-Z-Ject" Model D-800 probe, announced by *Doss Electronic Research, Inc.,* Kansas City, Mo., is actually a 1000-cycle pulse generator in probe form. Its output "shock-excites" an r.f. or i.f. tuned circuit to produce a damped-wave output signal at the circuit's resonant



frequency. This excited signal serves as a carrier frequency for the 1000-cycle probe output signal. The long, sharp tip of the probe is handy for getting into tight places and piercing printed-circuit board coatings. Price: $11.67, wired; $8.67, in kit form.

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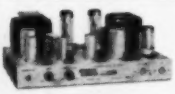

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(*Continued from page* 35)

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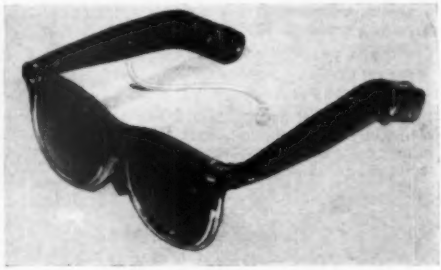

TUBE YOKE REMOVER

Now available from the *Walsco Electronics Mfg. Co.* (100 West Green St., Rockford, Ill.) is a solvent which enables a picture tube yoke to be slipped off without breaking the tube. Called "Ez-Off Frozen Yoke Remover Spray," the solvent is packaged in a spray-type can and is priced at 99 cents per can. -30-

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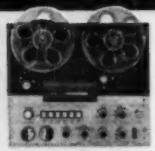

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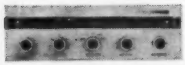

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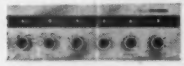

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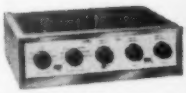

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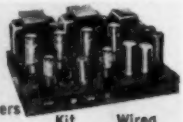

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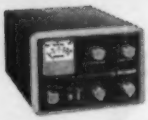

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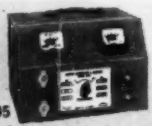

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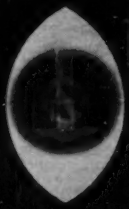

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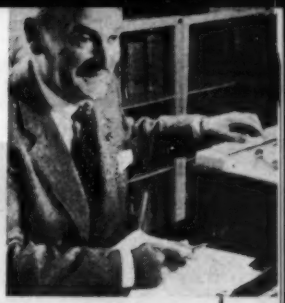
See Page 38 for the BEST BUYS in CITIZEN TRANSCEIVERS, "HAM" GEAR and TRANSISTOR RADIOS



Edward Startz is M.C. for "The Happy Station" program of Radio Netherlands.

VOICES from EUROPE

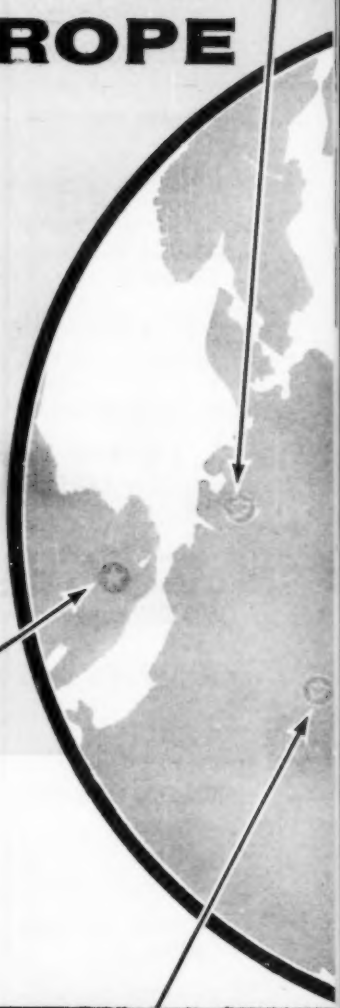
Short-wave broadcasts beamed to North America provide hours of informative and interesting listening

THE "Voices of Europe" are broadcasting daily to short-wave listeners in the United States and Canada. And a surprisingly high percentage of the programs are in English. By tuning in on these broadcasts, the listener can obtain a first-hand glimpse of life and customs in each land, gain some understanding of the people and their problems, and hear another side of the daily news.

The tables on the next four pages list the English language broadcasts from European short-wave broadcast stations. Frequencies, call letters, slogans, times and dates, and up-to-date program information are all included. Slight changes in frequencies can be expected, but the programs and times are those which these stations will follow during January and February.

PROGRAMING

Space does not permit a comprehensive listing of all the various and vitally interesting programs on the air, but on page 46 you'll find a few notes typical of European winter programing.



By
STEWART WEST

The sound of Big Ben (pre-recorded) is broadcast from London every hour on the hour.

A charming announcer in Switzerland, known as Pamela, can be heard regularly via the short waves.

TIME: EST (PST)	CITY, COUNTRY (NAME)	FREQUENCIES (kc.)
0630-0700 (0330-0400)	*Warsaw, Poland (Radio Warsaw) *News—0630 (0330)*	17800, 15275, 11800
0630-0700 (0330-0400) on Tue. & Sat.	*Helsinki, Finland (Radio Finland) *DX program—1st and 3rd Sat. 0630 (0330)* *Mailbag—Other Sat. 0630 (0330)*	17800, 15190, 11960
0700-0715 (0400-0415)	*London, England (B.B.C.) *News—0700 (0400)*	17740
0730-0830 (0430-0530)	*Warsaw, Poland (Radio Warsaw) *News—0730 (0430), 0800 (0500)*	17800, 15275, 11800
0800-0830 (0500-0530)	Paris, France (This is Paris) *News—0800*	17765
0845-0930 (0545-0630)	Lisbon, Portugal (Lisbon Calling) *News—0910 (0610)*	21495, 17880
0900-0920 (0600-0620) on Sundays only	Oslo, Norway (Radio Norway)	25900, 21670, 17825, 15175
0900-0930 (0600-0630)	*Stockholm, Sweden (Radio Sweden) *News—0900 (0600)* *DX program—Mon. 0920 (0620)*	17840
0915-1315 (0615-1015)	*London, England (B.B.C., North American Service) *News—1100 (0800), 1300 (1000)*	21675, 25840 (from 1100)
0945-1130 (0645-0830)	Berne, Switzerland (Switzerland Calling) *News—0945 (0645)* *DX program—Fri. 1020 (0720)* *Mailbag—Sun. 1030 (0730)*	21605, 17785
1000-1015 (0700-0715)	Vatican City, Vatican (Radio Vatican) *News—1000 (0700)*	15120, 11740, 9645
1000-1030 (0700-0730)	Copenhagen, Denmark (Voice of Denmark) *News—Tue. & Thur. 1000 (0700)* *DX program—Thur. 1020 (0720)* *Mailbag—Sat. 1015 (0715)*	15165
1030-1100 (0730-0800)	Belgrade, Yugoslavia (Radio Belgrade) *News—1030 (0730)*	15240, 11735, 9505
1100-1130 (0800-0830) on Mon., Wed. & Sat.	Vatican City, Vatican (Radio Vatican) *News—1100 (0800)*	21515, 17840
1100-1130 (0800-0830) on Mon. & Fri.	Helsinki, Finland (Radio Finland) *DX program—1st & 3rd Sat. 1100 (0800)* *Mailbag—Alt. Fri. 1100 (0800)*	17800, 15190, 11960
1100-1230 (0800-0930) on Sundays only.	Hilversum, Holland (The Happy Station) *Mailbag—1200 (0900)*	21565, 21480
1140-1210 (0840-0910) on Tue. & Fri.	Copenhagen, Denmark (Voice of Denmark) *News—1140 (0840)*	15165

TIME: EST (PST)	CITY, COUNTRY (NAME)	FREQUENCIES (kc.)
1145-1200 (0845-0900)	Belgrade, Yugoslavia (Radio Belgrade) *News—1145 (0845)*	15240, 9505, 7200
1145-1230 (0845-0930)	Berne, Switzerland (Switzerland Calling) *News—1145 (0845)* *DX program—Fri. 1120 (0920)*	21605, 15315
1200-1220 (0900-0920) on Sundays only.	Oslo, Norway (Radio Norway)	25900, 21670, 17825, 15175, 11850
1215-1300 (0915-1000)	Lisbon, Portugal (Lisbon Calling) *News—1240 (0940)*	17895
1230-1245 (0930-0945)	Athens, Greece (Radio Athens) *News—1230 (0930)*	9605, 6075
1315-1330 (1015-1030)	Vatican City, Vatican (Radio Vatican) *News—1315 (1015)*	15120, 11740, 9645
1330-1400 (1030-1100)	Belgrade, Yugoslavia (Radio Belgrade) *News—1330 (1030)*	9505, 6100
1345-1530 (1045-1230)	Berne, Switzerland (Switzerland Calling) *News—1345 (1045)* *DX program—Fri. 1420 (1120)* *Mailbag—Sun. 1430 (1130)*	9545, 7210
1500-1600 (1200-1300)	*Brussels, Belgium (This is Brussels)	6140
1615-1705 (1315-1405) Daily except Sun.	*Hilversum, Holland (Radio Netherlands) *News—1615 (1315)*	11730, 9590
1615-1815 (1315-1515)	*London, England (B.B.C., G.O.S.) *News—1800 (1500)*	11860, 9510
1630-1800 (1330-1500)	Villa Louvigny, Luxembourg (Radio Luxembourg)	6090
1700-1730 (1400-1430)	Berlin, East Germany (Radio Berlin International) *News—1700 (1400)*	11765, 9605
1715-1845 (1415-1545)	*Cologne, Germany (Voice of Germany) *News—1740 (1440)*	11795, 9605
1730-1800 (1430-1500)	Tirana, Albania (Radio Tirana) *News—1730 (1430)*	7157
1730-1800 (1430-1500) on Mon., Wed. & Fri.	Vatican City, Vatican (Radio Vatican) *News—1730 (1430)*	15120, 11740
1800-2203 (1500-1903)	*London, England (B.B.C., G.O.S.) *News—1800 (1500), 1900 (1600), 2100 (1800), 2200 (1900)*	9510, 6110
1800-0100 (1500-2200)	*Moscow, U.S.S.R. (Radio Moscow) *News—every hour on the hour.* *DX program—2nd & 3rd Sun. 1850 (1550), 2150 (1850)* *Mailbag—Sat. & Sun. 1930 (1630), 2230 (1930)*	9720, 9690, 9660, 9620, 9610, 9570, 7390, 7290, 7210, 7150

TIME: EST (PST)	CITY, COUNTRY (NAME)	FREQUENCIES (kc.)
1830-2000 (1530-1700) on Saturdays, 1900-2000 (1600-1700) on Sun., Tue., Wed. & Thur., 1945-2000 (1645-1700) on Mon. & Fri.	*Brussels, Belgium (This is Brussels) *News—1935 (1635) except Mon. & Fri. at 1945 (1645)* *Mailbag—Sat. 1930 (1630)*	11850, (to Africa on 11720, 9745)
1900-2000 (1600-1700)	*Budapest, Hungary (Radio Budapest) *News—1900 (1600)*	11910, 9833, 7220
1900-1925 (1600-1625) on Sundays only	Oslo, Norway (Radio Norway)	11850, 9610, 6130
1900-2200 (1600-1900)	*Cologne, Germany (Voice of Germany) *English programs—Sun., Wed. & Sat. 2110 (1810)* *DX program—2nd Mon. of the month 2015 (1715)*	11795, 9640
1930-1950 (1630-1650)	*Rome, Italy (Italian Broadcasting and Television System) *News—1930 (1630)*	9575, 6010
1930-2030 (1630-1730)	*Warsaw, Poland (Radio Warsaw) *News—1930 (1630)*	15275, 11800, 9675, 7315
2000-2030 (1700-1730)	*Sofia, Bulgaria (Sofia Bulgaria Calling) *News—2000 (1700)*	9700
2030-2120 (1730-1820) Daily except Sun.	*Hilversum, Holland (Radio Netherlands) *News—2030 (1730)*	9590, 6025
2030-2130 (1730-1830)	*Bucharest, Rumania (Bucharest Calling) *News—2100 (1800)*	11810, 9510, 7225, 7195, 6190, 5980
2030-2215 (1730-1915)	*Berne, Switzerland (Switzerland Calling) *News—2030 (1730)* *DX program—Fri. 2105 (1805)* *Mailbag—Sun. 2115 (1815)*	11865, 9535, 6165
2045-2115 (1745-1815)	*Stockholm, Sweden (Radio Sweden) *News—2045 (1745)* *DX program—Mon. 2105 (1805)*	9725
2100-2130 (1800-1830) Mon. through Fri., 2030-2130 (1730-1830) on Saturdays.	*Copenhagen, Denmark (Voice of Denmark) *News—Mon. 2100 (1800)* *DX program—Tue. 2100 (1800)* *Mailbag—Sat. 2030 (1730)*	9520
2100-2125 (1800-1825) on Sundays only	*Oslo, Norway (Radio Norway)	11850, 9610, 6130
2100-2230 (1800-1930) on Sundays only	*Hilversum, Holland (The Happy Station) *Mailbag—2200 (1900)*	9590, 6025
2130-2230 (1830-1930)	*Warsaw, Poland (Radio Warsaw) *News—2130 (1830), 2200 (1900)*	15275, 11800, 9675, 7315
2200-2255 (1900-1955)	*Prague, Czechoslovakia (This is Prague) *News—2200 (1900)*	11990, 9580, 9550, 7340, 5930

TIME: EST (PST)	CITY, COUNTRY (NAME)	FREQUENCIES (kc.)
2200-2330 (1900-2030)	*Budapest, Hungary (Radio Budapest) *News—2200 (1900)*	9833, 7220
2200-2230 (1900-1930)	*Bucharest, Rumania (Bucharest Calling) *News—2200 (1900)*	11810, 9510, 7225, 7195, 6190, 5980
2200-0100 (1900-2200)	*Cologne, Germany (Voice of Germany) *English programs—Sun., Wed. & Sat. 0010 (2110)* *DX program—2nd Mon. of the month 2315 (2015)*	11795, 9640
2205-2225 (1905-1925)	*Rome, Italy (Italian Broadcasting and Television System) *News—2205 (1905)*	9575, 6010
2215-2300 (1915-2000)	*Madrid, Spain (Voice of Spain) *News—2215 (1915)*	9363, 6130
2215-2245 (1915-1945)	*Stockholm, Sweden (Radio Sweden) *News—2215 (1915)* *DX program—Mon. 2235 (1935)*	9725
2230-2330 (1930-2030)	*Budapest, Hungary (Radio Budapest) *News 2230 (1930)* *2325 (2025)*	11910, 9833, 7220
2230-2300 (1930-2000) Mon. through Fri., 2200-2300 (1900-2000) on Saturdays.	*Copenhagen, Denmark (Voice of Denmark) *News—Mon. 2230 (1930)* *DX program—Tue. 2230 (1930)* *Mailbag—Sat. 2200 (1900)*	9520
2300-2330 (2000-2030)	*Sofia, Bulgaria (Sofia Bulgaria Calling) *News—2300 (2000)*	9700
2315-0000 (2015-2100)	*Berne, Switzerland (Switzerland Calling) *News—2315 (2015)* *DX program—Fri. 2350 (2050)*	11865, 9535, 6165
2315-0000 (2015-2100)	*Madrid, Spain (Voice of Spain) *News—2315 (2015)*	9363, 6130
2330-0000 (2030-2100)	*Bucharest, Rumania (Bucharest Calling) *News—2330 (2030)*	11810, 9510, 7225, 7195, 6190, 5980
0000-0400 (2100-0100)	Vienna, Austria (Radio Austria) *This is an experimental transmission.*	6155
0000-0025 (2100-2125) on Sundays only	*Oslo, Norway (Radio Norway)	11850, 9610, 6130
0000-0055 (2100-2155)	*Prague, Czechoslovakia (This is Prague) *News—0000 (2100)*	11990, 9580, 9550, 5930
0000-0130 (2100-2230)	*Cologne, Germany (Voice of Germany) *News—0025 (2125)*	11945, 9735
0015-0100 (2115-2200)	*Madrid, Spain (Voice of Spain) *News—0015 (2115)*	9363, 6130

* *Strong signals in United States and Canada*

"This Is London." The British Broadcasting Corporation has built up a world-wide following during the three decades it has engaged in short-wave broadcasting. The announcement, "This is London Calling" and the sound of Big Ben striking the hour are known in every corner of the globe. Nowadays, the General Overseas Service includes a variety of unusual programs, and the North American Service is frequently taped and rebroadcast in the United States on AM and FM.

A Youth Forum team is heard on Switzerland's Youth Magazine program.

Horst Krieger is the Short-Wave DX Editor for the Voice of Germany.

During the month of January, the BBC is sure to have something of interest for every listener. Their two best-known world affairs programs are "The World Today" (daily except Saturdays at 2050 EST), and "Serious Argument" (Wednesday at 2115 EST). At 1815 each Friday they will have a special documentary ("Training for the Services" on January 6, 13, and 20; "Solving the World's Food Problems" on January 27).

For sports fans, "Sports Round-Up" is a regular feature Monday through Saturday at 1745. Music lovers will be interested in "The Orchestras of Britain" (Saturdays at 2130 EST), "BBC Concert Hall" (Sundays at 1615), "Famous Churches of London" (Tuesdays at 2130), and "Listeners' Choice" (Wednesdays at 1715).

"The Happy Station." Since 1928 a pioneer short-wave broadcasting station—PCJ—in Hilversum, Holland, has been enthusiastically acclaimed by SWL's. To a very large extent, this endorsement has been credited to Edward Startz and his "International Happy Station Program." But Startz, who originates the ideas and hosts the program each Sunday at 2100, is modest about PCJ's success—he says that it is the inspiration of the listeners that keeps the show so lively.

An example of listeners' participation was scheduled for Christmas Day: a "Round the World Listener Salute" comprising 20 different tapes from as many different countries—all supplied by regular listeners.

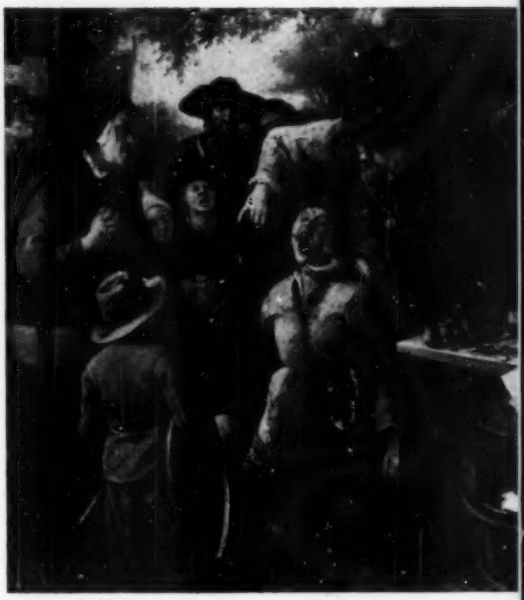
"Switzerland Calling." Swiss music enlivens the air at 2050 and 2335 with "Country Dancing Date" on Thursdays and "Jazz Panorama" on Wednesdays. On Saturdays at 2115 there is "Melody Train" with an hour of requests and musical variety. And on Sundays the "Swiss Sunday Special" provides music, information, and fun—including a mailbag section.

TUNING THE BANDS

The SWL tuning for European stations must contend with two problems. One of them is the vicious jamming of Western European broadcasts by transmitters in Soviet-controlled countries. Jamming sounds like a buzz saw and almost always obliterates the broadcast it is intended to cover. To evade such jamming, many stations shift frequencies a few kilocycles, hoping that it may be hours—or days—before the jammer catches on.

The second problem concerns the day-to-day variation in signal strengths. To reach American shores, European stations must beam their broadcasts over the Great Circle path. This means that somewhere along its path the radio signal either passes through or very near the Northern Auroral Zone. When the *Aurora Borealis* is active, there will be severe interference. The signal may lose strength or it may become completely garbled due to rapid fading. Thus, if you find conditions poor one evening and superb the next, don't be too surprised—it does happen.

(*Continued on page* 128)



Bettmann Archive

The Noise that Banishes Pain

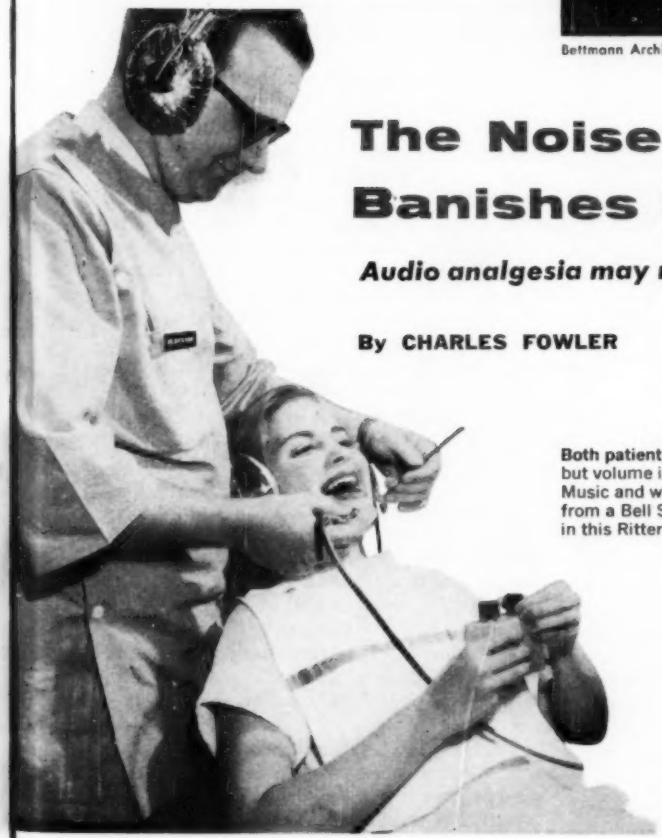
Audio analgesia may revolutionize dentistry

By CHARLES FOWLER

IF your dentist hands you a pair of earphones the next time you visit him, and tells you to dial your own anesthetic, don't be surprised. It is simply the latest evidence that music hath charms and, mixed in the proper proportions with something scientists call "white noise," can suppress even a nagging toothache.

The dentist calls his latest development *audio analgesia,* and he will tell you with enthusiasm that it is completely successful in about two-thirds of his cases. In fact, the dental profession has achieved such success with audio analgesia that doctors in many other fields of medicine are beginning to wonder if they, too, can use it.

Unusual Anesthetic. For successful analgesic action, two ingredients are needed: music and white noise. The latter is quite often called *waterfall*



Columbus Dispatch

Both patient and dentist wear earphones but volume is controlled only by the patient. Music and white noise are fed to the earphones from a Bell Sound tape-cartridge recorder in this Ritter Audiac installation.

Audio analgesia setup used by author includes outlet box and connecting cables, control box for patient, and set of Koss stereo earphones. Note different colored knobs on control box.

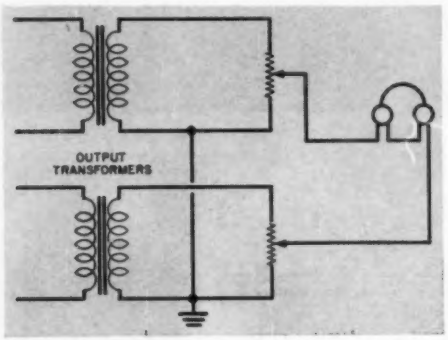


Fig. 1. This circuit was the end result of the author's experimentation with various circuits. Both dentist and patients reported that this one gave the greatest control over music and white noise in earphones.

sound by doctors because that best describes the steady hissing heard by patients.* The primary function of the music is to achieve a state of relaxation for the patient by distracting his attention and giving him something else to think about. Many patients report that the music alone is sufficient to relieve their habitual anxiety and to obscure the fleeting twinges of pain. The real pain inhibitor is the white noise, which is added to the music in whatever proportion the patient wants. If the patient is nervous, or very pain-sensitive, he can turn up the volume to a very high level, until almost any amount of what might be called "dental pain" can be readily blocked off.

And, according to doctors, that is exactly what happens: the pain is blocked off. It is their theory that our nervous system can take just so much stimulation. That stimulation may be in the form of pain or in the form of sound. If the nerve channels are filled up with sound, then relatively little pain can seep through. It will take time and many experiments to confirm or amend this theory, but the fact is that audio analgesia works. With its help, teeth have been extracted and, in recent experiments, babies have been born—all without pain. Audio analgesia may open untold doors, relieving pain in many situations where a more customary anesthetic cannot be applied.

Experiments with audio analgesia, begun a little over a year and a half ago in Boston, grew out of the observation that one of the unpleasant aspects of sitting in a dentist chair is the buzzing noise of the drill. Raising the level of background music played for patients' enjoyment helped to obscure the drilling sound and relieve the nervous tension of the patients.

Further experiments revealed that white noise was more effective than music because, by its very nature, it is all types of sound and thus better able to

*The "sound" of white noise is very similar to the inter-station hiss heard on some FM tuners.

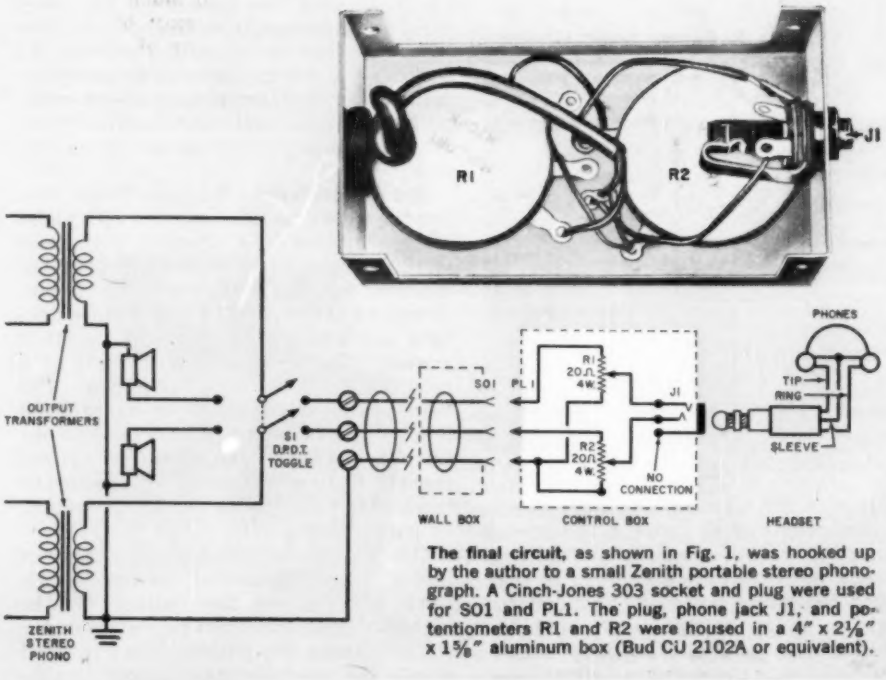
block out other sounds. Music is neither a steady nor a complete noise; other sounds can leak through from time to time. So experiments were continued with white noise as an obscuring agent; then it was discovered that more was being achieved than just relief from annoying noises. The pain threshold was being raised and, in many cases, blocked off completely

Make Your Own. If you have some Emory Cook records, a stereo phonograph and a pair of headphones, you, too, can have audio analgesia. The basic need is for two sources of sound feeding into a pair of stereo headphones through a control box. One sound must be music, the other white noise. The author, with the cooperation of his own dentist and a good many of his patients, has been able to develop a simple arrangement which is inexpensive yet has proven to be eminently satisfactory.

In essence, Cook records are played on a portable Zenith stereo phonograph. The sound is fed to a Koss stereo headset through two 20-ohm, 4-watt potentiometers. (Stereo enthusiasts will be dismayed to learn that this original arrangement is monophonic.) The essentials of the final wiring arrangement are shown in Fig. 1.

Starting with the phonograph, the wires leading from the output transformers to the loudspeakers were disconnected and a d.p.d.t. switch installed. In one position, the phonograph functions normally. In the other, the speakers are cut out and the earphone cables switched in. The switch wires are brought out to screw-type terminal strips and the earphone/control box cables connected to these strips.

The first section of the earphone cable terminates near the dental chair in a small metal box, attached to the baseboard and housing a Cinch-Jones socket. The other end of this cable goes to the terminal strip on the phonograph. This is sort of semi-permanent wiring. The second section of the cable starts with a matching Cinch-Jones plug and termi-



The final circuit, as shown in Fig. 1, was hooked up by the author to a small Zenith portable stereo phonograph. A Cinch-Jones 303 socket and plug were used for SO1 and PL1. The plug, phone jack J1, and potentiometers R1 and R2 were housed in a 4" x 2⅛" x 1⅝" aluminum box (Bud CU 2102A or equivalent).

nates in the control box, which has a standard phone jack to accept the phone plug used on most headphones.

Choice of Wiring. There are many different wiring arrangements possible for the two level controls. Several have been tried in addition to the one in Fig. 1; two others appear in Figs. 2 and 3.

Using the arrangement shown in Fig. 2,

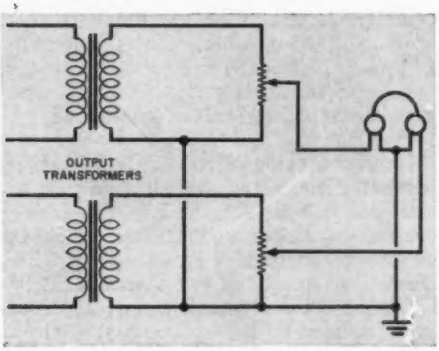
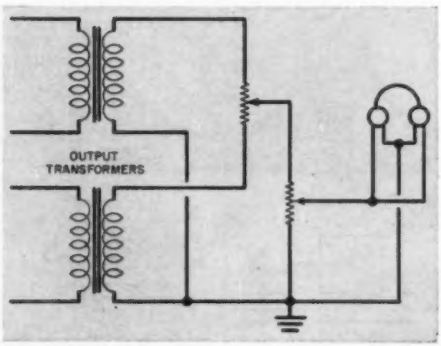


Fig. 2. This hookup, which feeds music and white noise into separate earphones, proved impractical.

Fig. 3. Patients tended to become confused when this stereo blending control arrangement was used.



music was fed from one channel to one ear, and white noise through the second channel to the other ear. It worked fine, but the patients didn't like it. If they turned the white noise off, and had the music on at low volume levels, then—in spite of the pads on the earphones—they could hear through the "silent" ear. Also, it gave them what several described as a "split" sensation.

The next experiment provided a blend control, as shown in Fig. 3. This was even worse. Nobody could figure out what to do with the knobs. Despite its growing popularity, stereo has still reached only a small part of the population, and few indeed understood what a blend control was or how it should be adjusted.

The final arrangement (in Fig. 1) has the two earphones in series across the two amplifier outputs. Music reaches both ears and white noise, also going to both ears, blends with it. The loudness level of each is separately controlled and there is no interaction between the two level controls.

Selection of components is not critical as long as the prime requirement of ruggedness is observed. The phones, in particular, are subjected to both physical and electrical abuse, since many patients keep the volume turned well up.

The Koss earphones work well. Use the newer models (SP-3) with a single, well-insulated cable going to one earphone and the connection to the other earphone over the headband. This is a good arrangement from the point of view of both patient and dentist; the fewer the number of wires running around, the better. Other stereo phones may soon be on the market—both Cook and Sargent-Rayment are reported to be in production.

Results Achieved. We have found during the weeks we have worked with audio analgesia, that it is effective with—and well liked by—at least two-thirds of the dentist's patients. This experience is confirmed by the reports of many other dentists now using this latest tool of medical science. The very elderly do not, as a rule, want to try something new. The very young are not able to comprehend how it works or what they should do. But, in between, patient after patient reports finding relaxation from nervous tension and a blanking-out of unpleasant or painful sensations.

One patient even caused a moment of alarm. When the dentist had finished his work and tapped the patient on the shoulder to indicate that he could remove the earphones, the patient didn't respond at all. He had fallen fast asleep. —30—

HI-FI FAN "ROLLS HIS OWN"

John Pritchett is one hi-fi fan who believes in getting something for nothing—or almost nothing. John owns eight recorders, and there's not a commercially pressed LP in the house.

Rather than buy records, John picks his music out of the air, records it, and files it away for future enjoyment. His studio houses three short-wave receivers which pick up broadcasts from around the world. And for hi-fi recordings, there's an FM tuner that pulls in 64 FM stations, providing him with some of the best FM coverage in the United States.

Located in the Appalachians near Boone, North Carolina, John's studio is only part of his hi-fi setup. He has wired all the rooms in his home to receive sound from the setup, so his family and friends can share in his hobby. Listening fare is apt to be anything from hillbilly songs to grand opera—John supplements his income as an education instructor by recording music of local folk artists, and he has recorded all Metropolitan Opera broadcasts for the past eight years. *—John Corey*

3 NEW STEREO/HI-FI BOOKLETS

If you're keen on keeping up with developments in hi-fi/stereo, you'll want to take advantage of three new booklets which manufacturers have made available for only 25 cents each. One booklet, "All About Stereo," is available from Bell Sound Division of Thompson Ramo Wooldridge Inc., Columbus 7, Ohio. A second, issued by Shure Brothers, Inc., 222 Hartrey Ave., Evanston, Ill., is entitled "The Art of Selecting, Playing, and Preserving Recordings." And a third, "Understanding High Fidelity," is distributed by Bogen-Presto, P. O. Box 500, Paramus, N. J. Be sure to include a quarter with your request for a copy of each of these booklets.

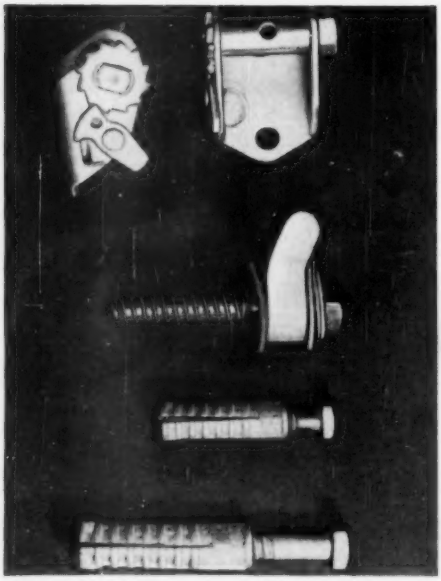
Guying Tips for the Ham Antenna Tower

By JACK DARR

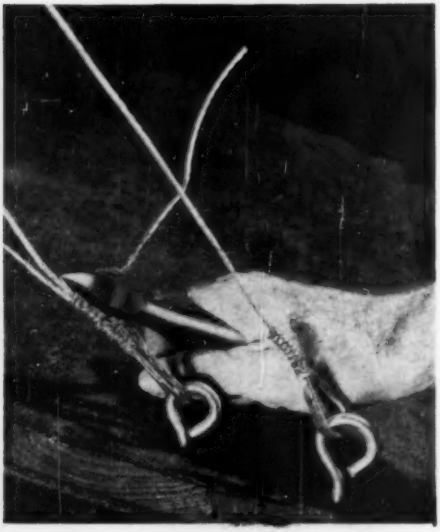
THERE was a time when amateur radio antenna towers were usually homemade affairs. But the widespread use of commercial ham and TV antenna towers has made the homemade tower almost as obsolete as the spark-coil transmitter.

Telescoping masts are ideal supports for light or medium-weight beams and can also hold up the ends of a doublet. For heavy beams, you can buy a mast that is bigger than you need, remove the upper sections, and end up with a tower strong enough to carry the load.

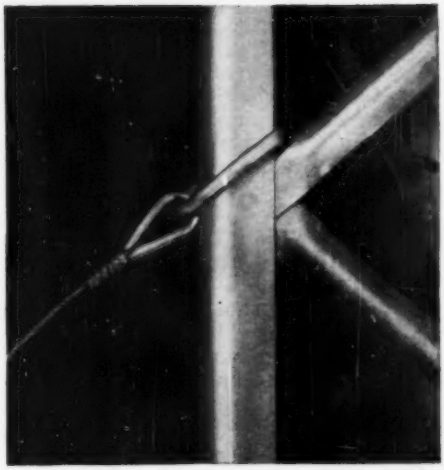
A tower won't carry your antenna for long, though, unless it is properly guyed. Never skimp on the guy wires and



Ratchet take-up anchor (two views, top) hauls in guy wire slack with the twist of a wrench. Another type of anchor (center) is a simple aluminum fitting with an eye for fastening guy wires. Lag screws and lead shields (two views, bottom) secure anchors to concrete; screw expands shield in drilled hole for tight fit.

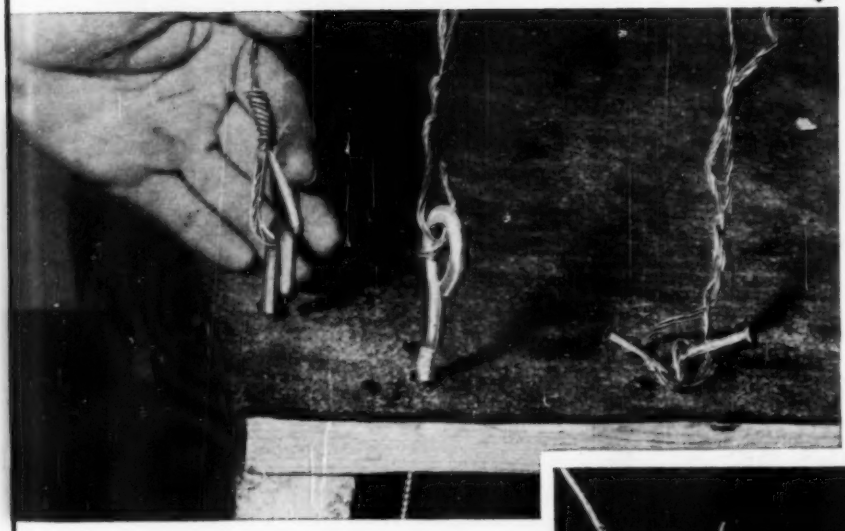


Tall towers and masts require guy wires running to the top and middle sections as well. Two guy wires can be attached to the same ring for medium towers, but high towers should have separate rings to anchor guys.

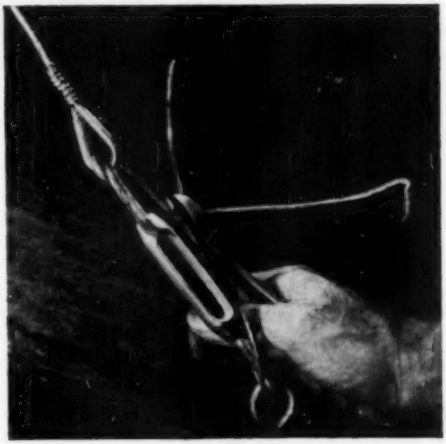


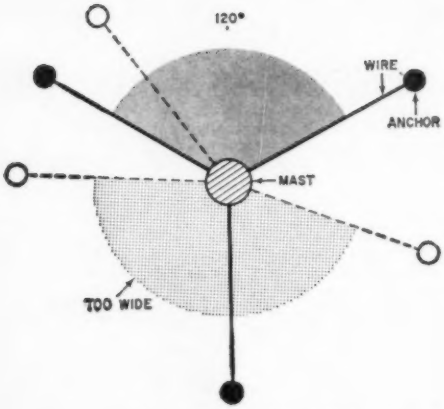
Always use a metal ring when you attach a guy wire to a metal tower; the sharp edges of the structure would eventually cut through unprotected bare wire.

Guy wires can be secured to wooden roofs with a 3" screw eye inserted into the rafter (left). A metal thimble loops the wire through the eye and takes the brunt of wear when metal rubs metal; twisting the wire around itself at least six times will hold it fast. Two poor guy wire fastenings (center and right) are examples of what what **not** to do.

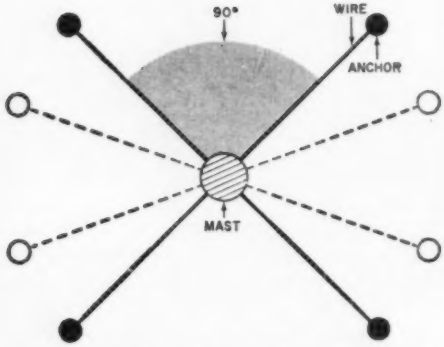


Use a turnbuckle to get the desired tension on the guy wire, with at least a six-turn tie and a thimble at the guy-wire end. Connect the turnbuckle to both the guy wire and the screw eye anchor. Take up any slack by twisting the turnbuckle's body, using an iron rod for leverage. Be sure to safety-tie the turnbuckle with scrap wire to prevent it from unwinding.





In three-wire guy systems, always have the guy wires equally spaced (solid lines) to provide equal bracing against all winds. Unevenly spaced wires (dotted lines) offer less support against strong winds.



Four guy wires offer maximum protection against high winds when spaced 90° apart. Avoid making angles too wide (dashed lines) or the mast may topple during the first big storm.

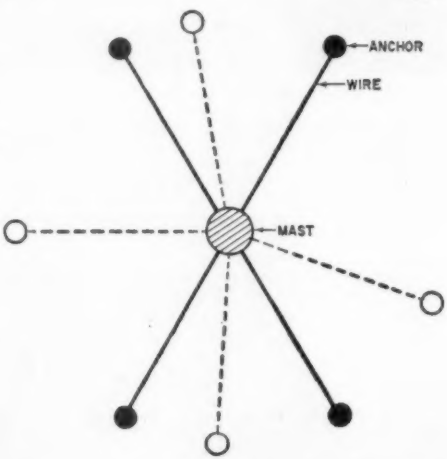
supports—a beam and rotator cost far more than a 50-cent length of wire.

Be sure to ground the tower. For a rooftop job, run a length of heavy solid wire—No. 6 aluminum or larger—from the base of the mast to a ground rod. Don't bend the wire sharply where it goes over the eaves, however. Lightning acts like a high-frequency signal and is "blocked" by such a bend. It may jump to a point several feet away rather than go through a sharp bend in a wire.

If the mast is mounted on the ground, drive a ground rod near the base of the mast and use a U-bolt to clamp the mast and the rod together.

If you live near the sea, where corrosion is a problem, use aluminum guy wires or very heavily galvanized steel, and spray all joints and fittings with plastic. It's also a good idea to inspect the whole installation thoroughly at least once a year.

Installing your antenna properly, whether it's a 150-foot tower or a 12-foot vertical, is just a series of small jobs: tying guy wires, fastening screw eyes, adjusting a turnbuckle, etc. If every one of these steps is done right, you'll have a tower that will stay up under almost all conditions (short of a wind that blows the house away). If you skip just one step you may wake up one morning and find your tower lying in the yard. To corn a phrase, take care of the little jobs, and the big job will take care of itself. -30-



Not all four-wire guy systems can be spaced 90° apart. A building may get in the way, or your back yard may not have the right dimensions. In such a case, make one wire pull against another (solid lines) for maximum all-round strength.

Sweet Sixteen

Compact enclosure delivers solid sound from sixteen 5-inch speakers

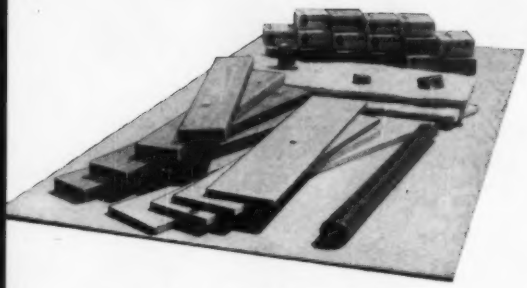
By **JIM KYLE,** K5JKX

CRISP, solid, bass reproduction—a hallmark of highest fidelity—can be yours for a little over $50 and a weekend's work. And there's no catch, even though $250 is a more likely price for a full-range speaker system capable of delivering useful output to 30 cycles and below.

The classic method for providing good bass response calls for big speakers, heavy magnets, low resonant frequencies, and carefully matched enclosures. This approach provides superlative sound in the bottom octaves, but its price tag is pretty super, too.

The performance of the "Sweet Sixteen" system is virtually unbelievable to those who haven't heard it. Coloration of sound—characteristic to some degree of almost every system—is conspicuous only by its absence. Measured response extends to 20 cycles—well below audibility—and is reasonably flat from that point up to just below 10 kc.

Unlike many hi-fi systems, this setup requires little driving power. Five "clean" watts applied to the system will drive all but the most hardened hi-finat-



Required parts are few, but it's best to gather all of them together in one place before you start to work on the system.

ics out of the room. And the system will handle more than 30 watts without audible distortion!

Multiple Speaker Setup. The secret of the setup is hinted at in a good many reference books, and several similar systems have been built and described. (See POPULAR ELECTRONICS, September, 1960, for one of the most recent and most elaborate systems, built for the Wright Air Development Center.) Yet the idea appears to have been almost completely ignored by most audiophiles.

Here's how it works. Instead of mating a big woofer (to handle the bass) with a specially designed tweeter (for mid-range and treble), a large number of small speakers are made to work in unison. At low frequencies, the small cones acting together move the air just as if they were one huge unit. In the mid-range, their low mass and high efficiency produce results not attainable with a single larger speaker.

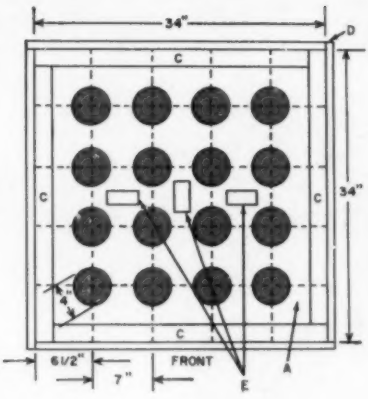
By using many speakers together, the peaks and valleys in each individual unit's frequency response tend to be statistically averaged into a smooth characteristic, difficult to attain with a single unit. The price tag is kept down, surprisingly enough, by the use of inexpensive replacement-quality speakers. Operated at extremely low power levels, these speakers are capable of hi-fi response even though the output from each speaker is so low that it can barely be detected at close range in a quiet room.

With enough of the small speakers working together, sound output comes up to a more-than-usable value. It's theoretically possible (and based on observations made with this unit, perhaps practical) to build a system which will reproduce frequencies as low as one cycle if you just use enough speakers.

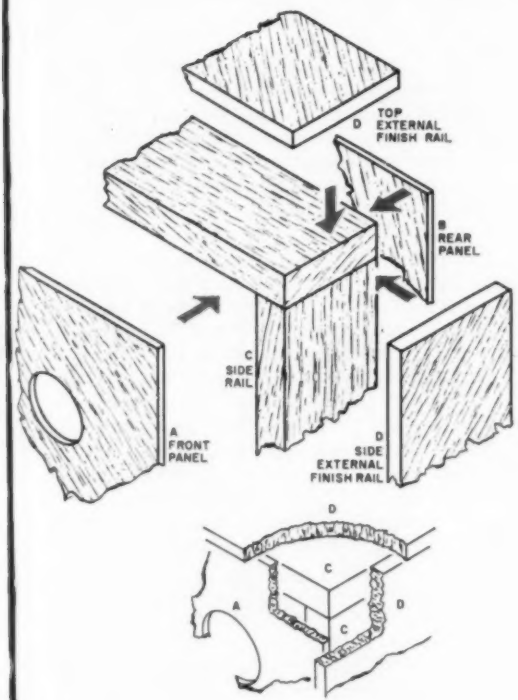
Interconnecting the speakers insures that the power fed to each remains small

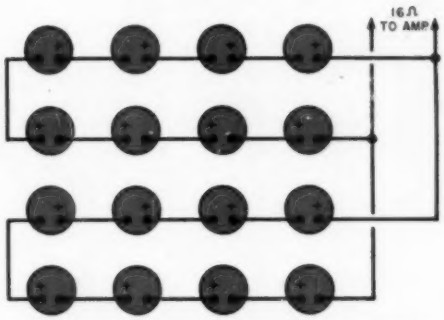
Speaker holes in front panel should be 4" in diameter and can be drilled most easily with a circle cutter mounted in a large electric drill. Side rails are intentionally designed to overlap at corners so they can be trimmed off to size.

Front panel (A) is drilled following layout at right before side rails (C) are attached. Spacers (E) can be cut to fit from pieces sawed off from side rails.



Final assembly is easy following pictorial below. External finish rails (D) hide joints in side rails (C); finish rails are covered with "Contact" material.



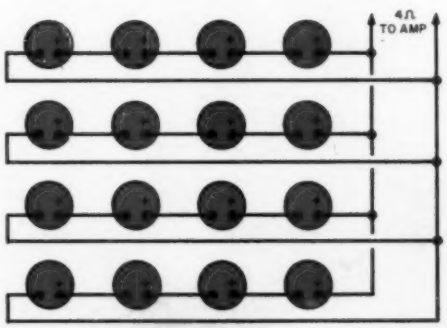


Wiring diagram for use with a 16-ohm amplifier output. See text for instructions on how to phase speakers properly.

BILL OF MATERIALS

2—34" x 34" x 5/16" plywood sheets (cut from a 3' x 6' sheet)
4—2" x 6" x 38" side rails
4—1" x 8" x 38" external finish rails
5 doz.—No. 8 flathead wood screws, 1¼" long
64—No. 6 sheet metal screws, ⅜" long
1 sq. yd.—Grille cloth
1 sq. yd.—Acoustic padding or Fiberglas insulation material
16—5" PM speakers (Quam 5A07 or equivalent)
6 ft.—No. 18 hookup wire
1 sq. yd.—"Contact" table-top material
Misc.—Black screen enamel, staples or tacks, solder, lamp cord, etc.

Speaker hookup for 4-ohm amplifier. Other series/parallel hookups are possible and should appeal to experimenters.



Connecting individual speakers is easy once you know the impedance you require. Simply use ordinary hookup wire and follow the appropriate schematic on page 57.

Decorative touch for finished system is furnished by wood-grained covering material purchased from a department store. Cut material to size before applying it.

—each cone's movement is in the neighborhood of only 0.01″ at top volume. Even loud drum passages reproduced at 30 watts cause no visible cone movement.

Simple Enclosure. Resonance problems and tricky enclosures are automatically eliminated in this approach, since they are important only when a speaker is being operated near its power limit. The baffle used with this system is a simple padded box to enclose the sound radiated from the rear of each speaker cone.

Two items are of prime importance for good results with this system. The speaker box must be solid, so don't try to skimp on the side braces or internal supports specified. Important, too, is speaker phasing—individual units must be connected with one another in such a way that all the cones move in the same direction at the same time.

If all of the units are identical, you'll have no trouble. But if you must mix models and manufacturers (and it's sometimes hard to find 16 of these speakers in stock at the same supply house), you'll have to check the phasing before making connections. This process will be described later.

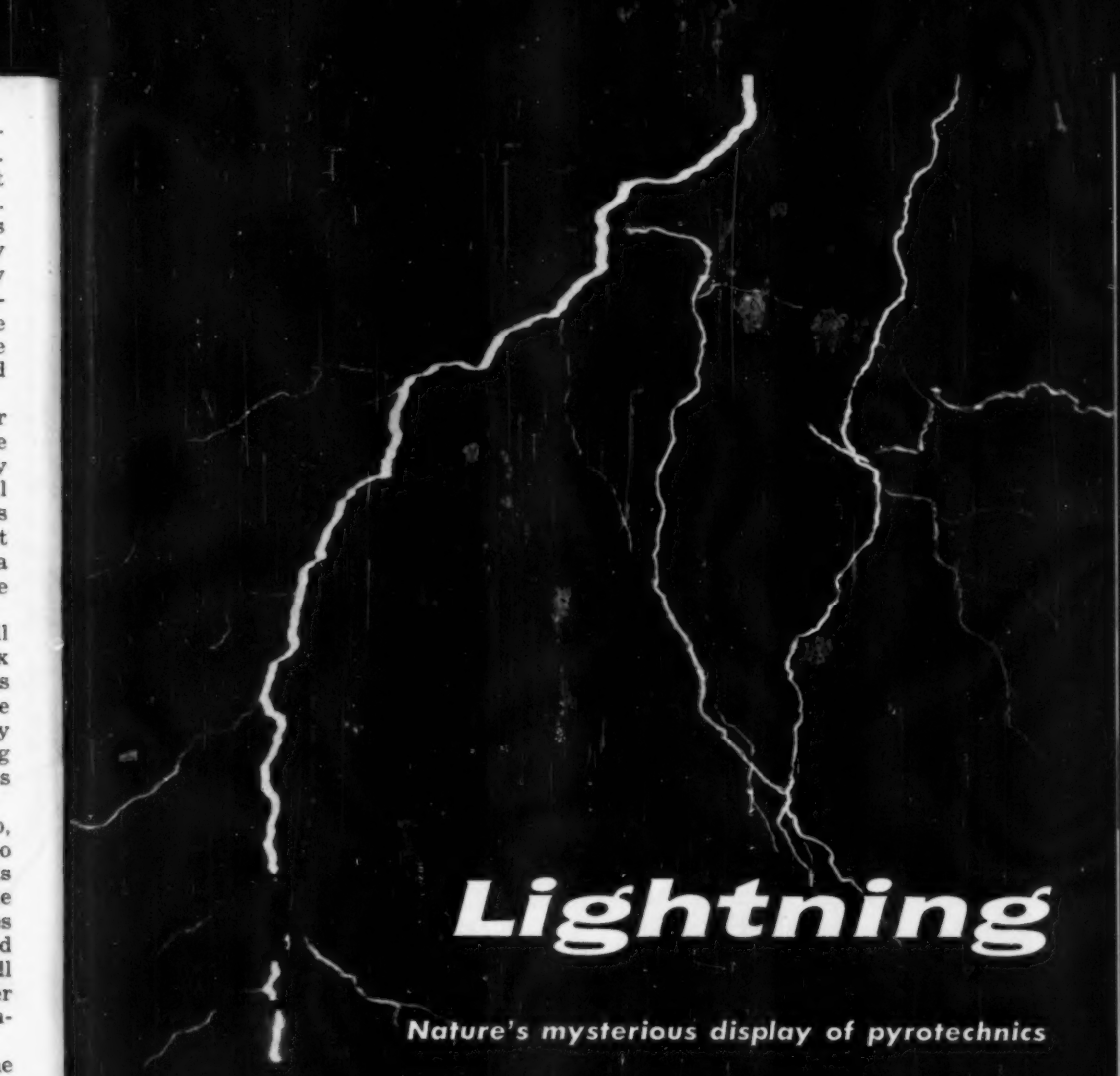
Layout and Construction. The first step, naturally, in building the system is to gather all the materials and components called for in the bill of materials. The only tools required are conventional ones —a ruler, saw, hammer, screwdriver, and soldering iron—but a ¼″ electric drill equipped with an adjustable hole cutter and with woodscrew speed bits will simplify construction.

Begin by laying out and cutting the front and rear plywood panels (*A* and *B* in the diagram) to size. Mark the location of the 16 speaker holes on the front panel (*A*) and cut them out. The hole diameter will be exactly four inches for a 5″ speaker.

If you're using a hole cutter in an electric drill, check the setting by cutting a hole in scrap lumber first. Then drill the hole halfway through the panel from one side, turn the panel over, and complete the cut from the other side. This will prevent the plywood from splintering when the cutter breaks through.

The next step is to attach the side rails (*C*) to the front panel. Note that the rails are overlapped at the corners in

(*Continued on page* 122)



Lightning

Nature's mysterious display of pyrotechnics

By ART ZUCKERMAN

AFTER putting the finishing touches on a guy wire, Bill Robbins climbed down from the roof. Once back on the ground, he looked proudly at the several antennas rising up from the roof of his new suburban home. With all that stuff up there, Bill thought, this is one house that doesn't have to worry about lightning!

But a week later the granddaddy of all thunderstorms struck. One colossal bolt made a direct hit on Bill's house, starting a roaring fire in the wood-frame structure, and at the same time knocking out the phone. A grimy Bill watched dazedly as his home went up in flames. And he dumbfoundedly asked, "How could it happen? Those antennas . . ."

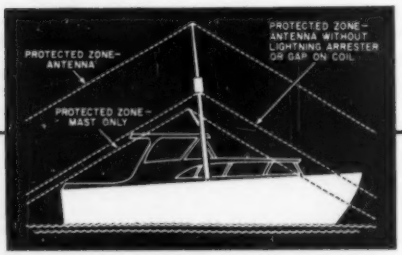
If anything, those antennas had probably guaranteed that the house would take a damaging lightning strike. Their presence on a building that was already the tallest thing for miles around provided a natural pathway for lightning. And the fact that the antennas weren't tied in with a good lightning protection system meant that the lightning, once

it struck, had nowhere to go but into the radio and TV gear and into the non-conducting structure of the house.

Actually, had the antennas been connected to a protection system—or at least been properly grounded—they could have made a very effective contribution to the safety of the house.

What Is Lightning? Just how lightning is generated we can't say for sure. But we know that it's the world's most colossal spark, created by the discharge of stupendous amounts of static electricity. It can carry a punch of hundreds of millions of volts, a current of 1000 to 100,000 amperes or more.

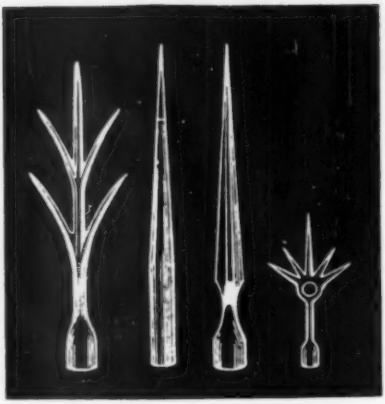
We also know that there are two basic types of lightning. The so-called "cold" variety has extremely high voltages, combined with relatively low amperages. It hits and disappears within 1/10,000th of a second. It doesn't often start fires, but the enormous pressure of its passage can literally explode whatever it hits. "Hot" lightning, on the other hand, has extremely high amperage but relatively low voltage. With a core path temperature as high as several thousand degrees, this is the type that almost invariably starts fires.



LIGHTNING PROTECTION AFLOAT

If you're a boating enthusiast, you'll be concerned with lightning protection afloat. The marine radio antenna of a small boat, if it's a metal rod type, can generally be depended on to do a bang-up protection job—provided that it's linked to a metal hull or connected to a ground plate in a wooden hull by No. 8 copper cable. If a wooden hull has no ground plate in contact with water, the cable can be run over the side of the boat, into the water.

A word of caution: the above does not apply to a non-conducting antenna mast with a spirally-wrapped conductor. But any mast can give protection if you put an air terminal on top and link it with No. 8 copper wire conductor down to ground.



Air terminals, commonly called "lightning rods," are an important part of a protection system. Properly installed, they are the highest points on protected structures, wired to dump thousands of amperes of static electricity harmlessly into the ground.

Like all electric sparks, lightning results when the potential between negative and positive charges becomes great enough to cause arcing. In some cases, the arcing goes through a barrier of air between the negative charge in a storm cloud and the positive charge of earth. While we don't know the exact mechanics by which this potential is built up, we do know the rough sequence of events.

A thunderstorm is generated when a layer of cool air overruns a mass of low-lying, moist, warm air. The warm air tends to rise through the cool air, causing its moisture to condense into water droplets. This movement of air current against air current—and possibly of droplet against droplet—generates staggeringly large quantities of static electricity.

For some reason, negative charges tend to collect in the lower layers of a storm cloud and positive charges in the upper layers. One theory is that raindrops falling through the cloud pick up negative ions and deposit them as they pass through the lower layers. In any event, the massive negative potential of the lower cloud layers induces a matching positive potential in the earth below.

As our highly-charged thundercloud scuds across the skies, the corresponding positive charge on the earth follows

along below, chasing after the airborne source of negative potential. The attraction between the opposing charge causes corona-like negative streamers, or stroke leaders, to descend from the cloud. As they approach the ground, these negative streamers become the focal point for the earth's positive charge.

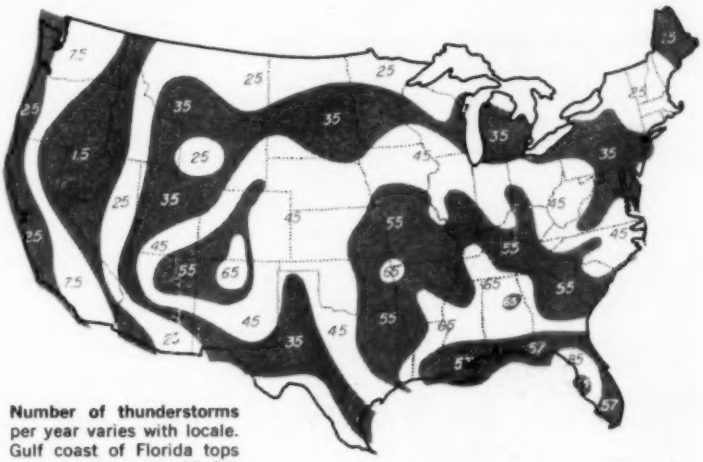
Any elevation or structure that will tend to shorten the gap between stroke leader and ground is climbed by this positive charge. Reaching the top, it sends positive streamers up from the elevation. The take-off point for these positive streamers can be anything—an antenna, a flagpole, a silo, a house, or—if he is out all by himself in open country— a man.

When negative and positive streamers meet, a tremendous current flow occurs at the meeting place, and a huge return stroke races back up the path created by the descending streamer. At the same time, an immense quantity of raw electrical power is released into the earth. Whether damage will result depends on what physical objects this power must pass through to reach the earth proper.

Obviously, lightning going through such non-conductors as wood or brick meets with tremendous electrical resistance. But the massive electrical energy contained in the lightning will not be denied; it smashes through this resistance. In the process it generates enough heat to set fire to—or perhaps even melt—the structure it hits.

Protection System. If the lightning hits a good electrical conductor, however, it takes this path of least resistance, and its energy is carried harmlessly into the ground. In essence, a lightning protection system is nothing more than a good conductor, designed to provide the most likely target for lightning and offer a safe pathway to ground for the lightning when it does strike.

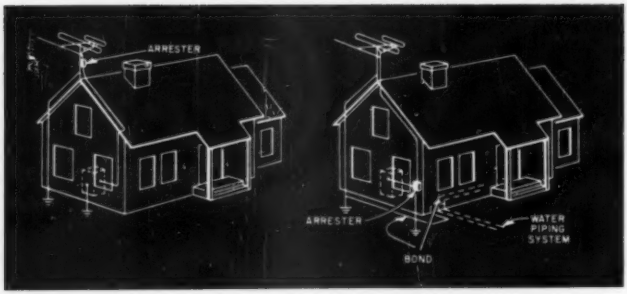
Since objects which shorten the gap between the descending negative stroke leaders and the earth's positive potential are the most likely lightning targets, they form the ideal basis for a protection system. In fact, the obvious thing to do is to make part of that system the highest point on the house.



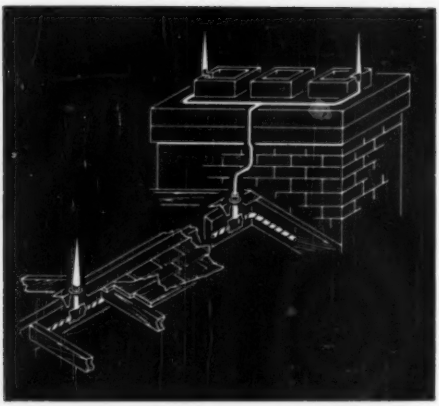
Number of thunderstorms per year varies with locale. Gulf coast of Florida tops rest of nation with 85-95.

This highest point is familiarly known as the lightning rod. The modern version of Benjamin Franklin's invention is a far cry from the large, often ornate creations of earlier days. It even goes by a different name—the air terminal. Today's air terminal is pencil-thin and pointed, deliberately designed to be as unobtrusive as possible.

An air terminal by itself is a pretty useless item. In fact, as the initial point on an electrical conduction system, it is a hazard, an open invitation for lightning to pay a visit. The vital part of the sys-



Any antenna can serve as an air terminal in a protection system. The antenna mast should be grounded directly if a high-impedance lead-in is used; lightning arrester should be mounted at same level as radio equipment as shown in drawing at right above. Additional air terminals should be installed as shown below, left, if antenna is not centrally located.



tem is a network of cables terminating in a ground rod, buried deep in moist earth.

How About You? Is it really necessary to have a full protection system? That depends primarily on where you live. If your neighborhood is heavily built up and there are a lot of tall objects in your immediate vicinity, danger is greatly reduced. But if you're out in the relatively wide-open suburban or rural spaces—in an area that gets a lot of storms—then it's a good idea to make the investment.

As a rule of thumb, for every thunderstorm that occurs within a square mile of your home, you can figure on one or two lightning strokes hitting within said square mile. If this adds up to, say, 50 storms a year, you have to reconcile yourself to accepting 50 to 100 strokes annually within half a mile of your house.

Though lightning invariably strikes the tallest object handy, it is a temperamental phenomenon and has been known to hit a small house sitting smack between two tall buildings. This is so much the exception, though, that there isn't much point in worrying about it. Actually, if you're near a tall, grounded metal structure, you will benefit from the umbrella of protection it provides. A 100-foot grounded steel tower, for example, should give complete protection to everything within a 50- to 100-foot radius. If your house is no farther away than twice the height of a grounded, conducting structure, you should be fairly secure.

A good, properly-engineered protection system costs between $300 and $400 to install, and there are good reasons for this seemingly high price tag. Let's examine a properly set-up system in detail.

Air to Ground. The air terminals at the top are usually made of copper for maximum conductivity, and it generally takes several of them to do the job. They are installed at intervals along every single high point of the house, such as gables, roof peaks, and chimneys. In fact, a chimney whose diagonal measures more than four feet requires two air terminals. On ridges, air terminals should be spaced no more than 20 feet apart.

The conductor cables are usually heavy affairs of copper—they weigh 187½ pounds per 1000 feet, are made up of 17-gauge strands, and interconnect the air terminals. Each air terminal must also have at least two down conductors, so

(*Continued on page* 120)

The Intermodulation Distortion Analyzer

Continuing our series on test instruments for hi-fi equipment, we move on from the harmonic distortion analyzer we discussed last month to take up another popular testing device—the intermodulation distortion analyzer.

IF music for the solo flute happens to be your favorite dish for an evening's hi-fi fare, intermodulation distortion in your hi-fi system is among the least of your worries. But if you're like most audiophiles in your musical tastes, you prefer other instruments (more likely, even, groups of instruments) to the solo flute. And in this case the IM ratings of the various hi-fi components are important, since they have a lot to do with how your setup sounds.

Intermodulation distortion will occur when two or more separate frequencies are fed through an amplifier (or a speaker,

By G. H. HARRISON

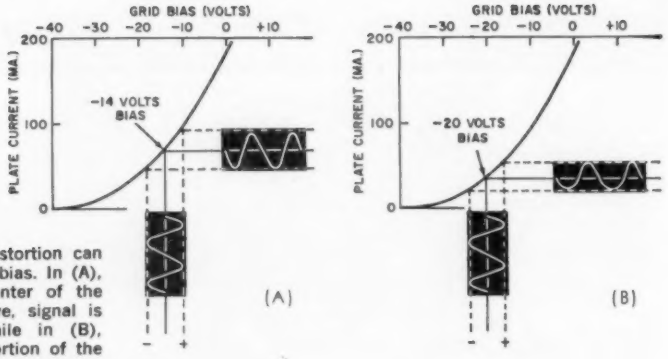
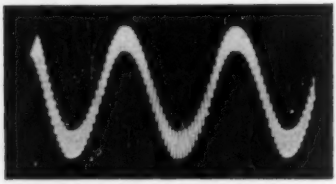


Fig. 1. Intermodulation distortion can be the result of improper bias. In (A), with grid bias at the center of the linear portion of the curve, signal is relatively undistorted, while in (B), operation on non-linear portion of the curve distorts the signal as shown.



Oscillogram of output waveform using combined 60- and 4000-cycle signals, −14 volts bias. Note its symmetry.

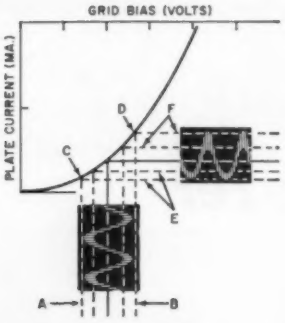
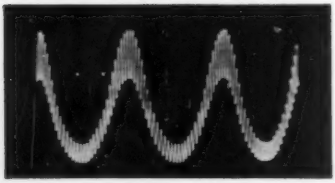


Fig. 2. High-frequency component of combined high- and low-frequency signal is distorted as in Fig. 1(B) above—see text.



Oscillogram showing distortion of the high-frequency component. Tube was overbiased, as in Fig. 1(B) and Fig. 2.

a tape head, a phono cartridge, etc.). Because no piece of equipment has a perfectly linear response, some interaction takes place between these signals, causing them to change—i.e., distort—each other slightly. To put it another way, one *modulates* the other, in much the same way that an AM transmitter modulates the r.f. carrier.

A flute note, for example, could easily be modulated or distorted by a cello tone or a drum beat. And since most music is played not only on flutes, cellos, and drums, but also on violins, trumpets, and many other instruments, the intermodulation problem can get very complicated in a poorly designed amplifier or other component. The resultant sound can be just as unpleasant—perhaps even more so—as that caused by the better known and more generally understood harmonic distortion. (See the December, 1960, issue of P.E. for more on this subject.)

What IM Is. Before we get into the matter of measuring intermodulation, it might be a good idea to talk a little more precisely about what it is. And perhaps the easiest way to understand IM is to see how it can develop in a component such as the ever-present vacuum tube. First, let's review a little basic vacuum-tube theory.

As you know, several kinds of curves can be drawn to illustrate any tube's operating characteristics. Figure 1(A) shows one such curve, the so-called I_pE_g curve, which plots changes in the tube's plate current as the grid voltage is varied. In the case of this particular tube (a 6L6), no plate current flows when the

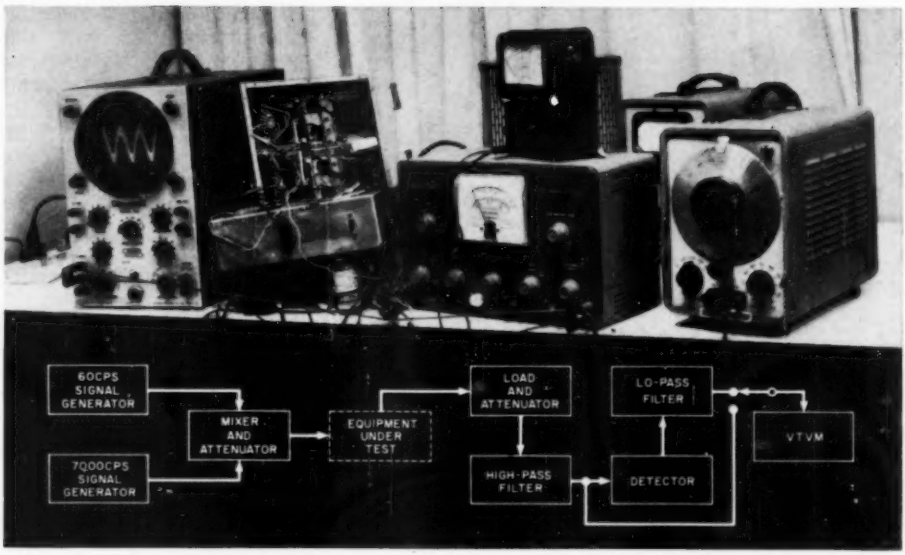


Fig. 3. Setup used to obtain oscillograms on opposite page and block diagram of equipment required; IM analyzers, such as the Heath AA-1 shown here, combine all blocks above except dotted box.

grid voltage is about -40 volts. With -30 volts bias, there is a 10-ma. current flow; with -20 volts bias, a 35-ma. flow.

As the curve shows, one portion is considerably straighter—more linear—than the rest. If the tube is biased to operate in this portion of the curve, then a 4-volt change, either positive or negative, on the grid causes a change of about 25 ma. in the plate current. (In this example, the tube is biased at -14 volts, standard for a pentode-connected 6L6 with 250 volts on plate and screen. Under these conditions, no-signal plate current is about 70 ma.)

Figure 1(B) shows what happens if the same tube is biased at -20 volts, shifting the operating point to the non-linear portion of the curve. Now a 4-volt *positive* signal swing will cause a 20-ma. change in plate current, but a 4-volt *negative* swing will cause the current to shift by only about 15 ma. Figure 3, above, shows the various instruments as well as the breadboard circuit we set up to operate under these conditions.

The unequal amplification of positive and negative grid swings in this case is responsible for intermodulation distortion. Let's see how this comes about. Suppose that instead of a single-frequency sine-wave input signal such as the one used in Fig. 1, we now apply two simultaneous signals (Fig. 2) to our tube operating in the non-linear portion of its curve. One is 60 cps, the other about 4000 cps. With the 60-cycle signal at 8 volts, peak-to-peak, and the other at 2 volts, we get a 4:1 voltage ratio between the two frequencies, which is standard for IM tests. (Actually, the frequencies usually used in standard IM test equipment are 60 and 7000 cps. We used 4000 cycles for these waveforms because a signal at this frequency can be seen superimposed on the 60-cycle signal in the oscillograms far more easily. In addition, the exact frequency of the signals is not at all critical.)

The low-frequency signal will make the plate current swing from about 20 to 55 ma., while the high-frequency signal will cause smaller variations across the path of this swing. Now here's where the intermodulation distortion comes in. Although the high-frequency signal injected into the circuit was of constant amplitude, it is far from constant in the output circuit. When the low-frequency signal is negative, as shown at (A) in Fig. 2, it swings the tube into the portion of the characteristic slope where amplification is least, as shown at (C). On the

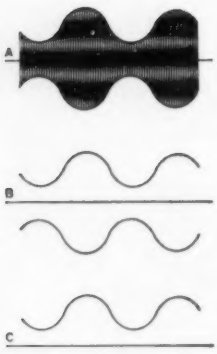


Fig. 4. Original high-frequency signal (A) used in intermodulation distortion test has been visibly modulated by 60-cycle input signal. Signal (A) is demodulated (B) and rectified (C). Signal (C) is distortion component.

positive swings, on the other hand, (B), the tube operates on a steeper part of the slope where amplification is greater (D). Thus the low-frequency signal modulates the high-frequency component, causing its amplitude at (E) to be less than at (F).

This effect—one signal affecting the gain of another—is known as intermodulation, or, more correctly, intermodulation distortion. Since no tube made has absolutely linear characteristics (although some come so close that the difference isn't worth quibbling about), all of them produce some intermodulation distortion.

And tubes aren't the only offenders. A curve similar to the tube's characteristic curve can be drawn for any component—a transformer, an amplifier, or even a complete record playing system from cartridge to speaker. Such a curve is known as the I-O (input-output) characteristic. Since it will always be slightly curved, some IM will always take place.

A speaker cone, for example, may be more sensitive at the center of its excursion than at the outer limits of its travel. If it is being driven back and forth by a low-frequency signal, a superimposed high-frequency signal would be reproduced with greater amplitude at one part of the cone's excursion than at another. Microphones suffer from a similar malady.

Measuring Amplifier IM. Now, since we understand IM, let's get down to the business of measuring it, and take a look at the instrument designed to do the job. The block diagram in Fig. 3 shows the Heath Audio Analyzer AA-1, a typical intermodulation distortion analyzer.

Two signal generators feed their outputs to a mixer-attenuator circuit. (The 60-cycle "generator" is simply a network which taps the 60-cycle line frequency from the filament transformer winding and applies it to the attenuator.) The oscillator has its own separate level control so that the standard ratio of high-to-low signal voltage (4:1, as mentioned earlier) can be adjusted.

The two signals are fed into the equipment under test. The amplifier output is fed back into the IM meter, where it is terminated in the proper load. The signal appearing across the load is channeled through a series of hi-pass filters which completely eliminate the low-frequency component and leave only the high-frequency signal—see Fig. 4(A). Although the major swings of the 60-cycle signal are gone, the variations in the amplitude of the high-frequency signal are clear.

The next stage in the IM unit is a detector, just like the one in your radio receiver. It takes the modulated signal shown in Fig. 4(A) and demodulates it, leaving only the wave envelope in Fig. 4(B), then rectifies this remaining signal to isolate the 60-cps modulation signal as in (C). This 60-cycle signal is routed through a low-pass filter to strip it of any remaining traces of the high-frequency signal, and its amplitude is then read on a VTVM.

As with harmonic distortion, we express IM as a percentage. In our example, the remaining 60-cycle signal, which represents intermodulation, is measured as a percentage of the entire high-frequency signal.

Incidentally, you don't need external load resistors to measure IM distortion with the Heath AA-1—it has 4-, 8-, 16-, and 600-ohm load resistors built in. With the amplifier output connected to the AA-1 input, you can select the proper load resistor and automatically switch it into the circuit with the front panel knob. The vacuum-tube voltmeter which measures the percentage of IM can also be used separately, as an audio VTVM or a wattmeter—the front panel is calibrated for both.

Obviously, an intermodulation analyzer—actually a combination of instruments arranged in one case—is the most convenient device for measuring IM. But

(*Continued on page* 116)

CB Under $100

Lafayette's HE-20 provides top value at new price level

FLEXIBILITY is rapidly becoming the most desirable feature to be sought for in CB equipment. In the larger cities where crowding on a few channels has reached serious proportions, multiple transmit and receive positions (all crystal-controlled) are the only solution. A tunable receiver has numerous advantages in spotting clear channels or working cross-channel. POP'tronics was pleased to see all of these features built into the new HE-20 (Lafayette Radio, 165-08 Liberty Ave., Jamaica 33, N. Y.) which sells for $99.50.

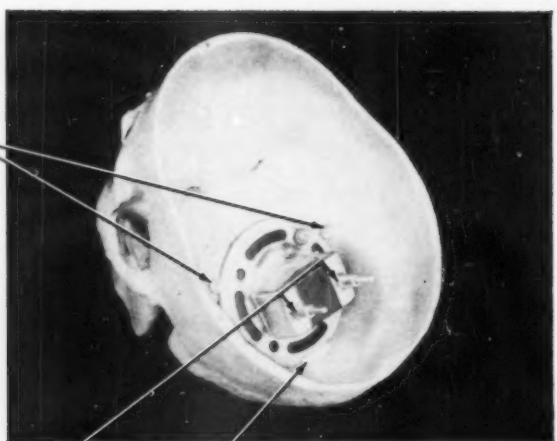
BOX SCORE

	Excellent	Good	Fair	Poor
Talk Power	✓			
Selectivity		✓		
Sensitivity	✓			
Squelch	✓			
Noise Limiting		✓		
Stability	✓			
Operating Ease	✓			

The HE-20 also has a built-in combination S-meter-milliammeter which can be switched over to check the transmitter's plate current. Eight-tube performance of the single-conversion receiver is possible due to triple functions of a 6T8 in the noise limiter, second detector and first audio stage. The noise limiter is a series gate type that is left in the circuit at all times; its effect on voice is negligible. The HE-20 is normally supplied with channel 9 crystals and a ceramic microphone.

The dial of the HE-20 is calibrated in CB channels. Four crystal-controlled transmit and receive positions may be selected by the switch in the lower left-hand corner of the panel.

By LOU GARNER



Loudspeaker is held in place by two mounting screws and scrap plastic rod. Chassis mounts on studs projecting from rear of speaker; spacers prevent the chassis from shorting against the speaker frame.

Thinking Man's Radio

Looking for an off-beat project?

Here's one that's sure to attract attention!

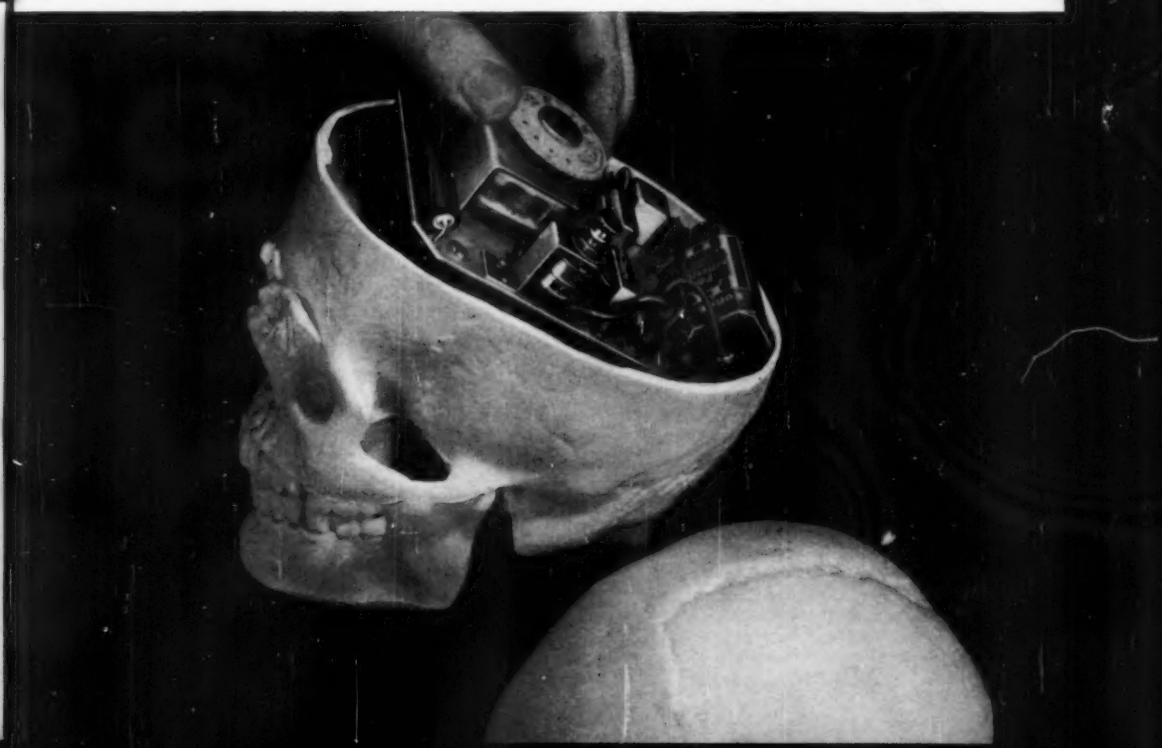
EASILY ASSEMBLED in one or two evenings, the "Thinking Man's" radio is an ideal off-beat project for the electronics hobbyist. Its unique appearance makes it a superb gift for "the man who has everything"—or you might want to keep it for your own office desk or den.

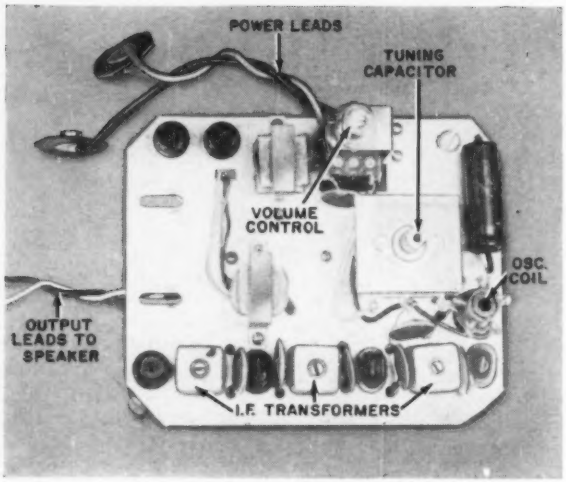
Basically, the radio is a battery-powered six-transistor broadcast set. But its cabinet is a life-size model of a human skull! The chassis is mounted where the brain would normally be, and the speaker is placed so that the sound seems to come from the vicinity of the jaw.

Construction. The skull comes in a moderately-priced kit ($4.95) made by Superior Plastics Inc., 426 N. Oakley Blvd., Chicago 12, Ill., and sold in toy and hobby shops. It is assembled with plastic cement. Don't cement the top of the skull—you'll want to remove it to get at the receiver's controls.

The receiver itself is adapted from a Lafayette kit, No. KT-119A. The parts could be purchased separately, of course, but with the kit there is no chance of the parts not matching or not working properly. Assembly instructions are in the manual that comes with the kit.

The chassis supplied is too large to fit in the skull and must be cut down to about 3 9/16" x 4½"; the antenna must also be replaced with a smaller version. Either Lafayette's MS-329 or MS-299 antenna can be used, but you'll have to remove several turns from the "299" so it will match the kit's tuning capacitor. If you decide to cut a new chassis out of sheet aluminum rather than cutting down the one supplied, it's best to follow the





Follow parts layout at left if you cut a receiver chassis from sheet aluminum. The two slots shown at extreme left of chassis fit on speaker mounting studs.

same parts layout. The receiver is fairly sensitive and another layout might cause oscillation.

When the wiring is finished and double-checked, connect the output transformer's leads to the speaker. Trim the transistor leads to about $\frac{3}{8}$" long and place them in their proper sockets. Connect a 9-volt battery (such as the Burgess P-6) to the power leads and turn the set on.

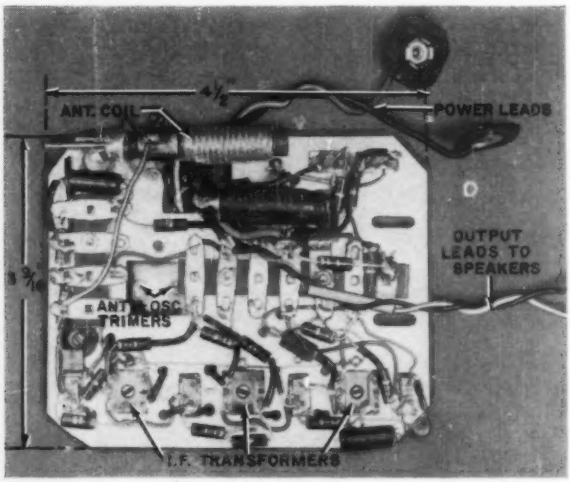
With the volume turned up full, a few stations should be heard as the tuning capacitor is rotated. Don't worry if the set seems to be lacking in sensitivity—like all superhets, it has to be aligned for best performance.

Alignment. Your local service shop can put the set in tip-top shape; or, if you have an r.f. signal generator, you can do the job yourself.

Make up a 3" to 4" loop of 10 to 15 turns of ordinary hookup wire and place it near the receiver's antenna coil. Connect the loop to the generator's output cable and set the generator to produce a modulated 455-kc. signal.

Turn on the set and, using an insulated

(*Continued on page* 121)



Use extra care in soldering to the terminal strips. Both of the strips are so close to the chassis that a blob of solder could very easily cause a short.

Short-Wave Report

By HANK BENNETT
W2PNA/WPE2FT

MANY SWL's inquire about the work performed by Your Short-Wave Editor. Just what do we do? How is the column prepared? When is mail answered? These questions, and others, are often asked—we'll do our best this month to answer a few of them.

The task of preparing a monthly column is not easy although it is, in many respects, an enjoyable one. The hardest work is performed by the listeners, who devote countless hours to monitoring, recording, logging, and reporting. Without these reports, this column would cease to function. They come in daily, are sorted from the general mail (such as requests for leaflets and letters asking for specific data), and are checked out for accuracy and information value. A few are put aside immediately due to incompleteness (times heard and/or frequencies not given). Very rarely, reports are discarded for being obviously false.

Checking out a total of several hundred reports each month accounts for the greatest share of the time devoted to the preparation of the column. Then, the reports are screened in a search for the most valuable ones. Due to space limitations, we can use only a small percentage of them although we do try to include reports from as many DX'ers as possible. The best ones are rechecked and edited for their "meat"; many personal observations must be omitted to conserve space.

After the best items are chosen and alphabetized, the writing of the column itself takes but a few hours. The actual column (as you see it in print) is held up until the last moment to insure inclusion of any late frequency or schedule changes.

Afterwards, the listening post here has to be put back in order. The reports are sorted and filed, and certain ones selected for immediate answering. *All* reports are acknowledged. In the case of new reporters, we try to ackowledge items at once; our regular contributors hear from us periodically.

General mail is answered whenever we have a few spare moments. Your Short-Wave Editor, with the able assistance of a most patient wife, answers three to four hundred letters monthly. Requests go out to stations for new operating schedules, and information we feel will be of interest is sought. In all, some 50 to 60 hours per

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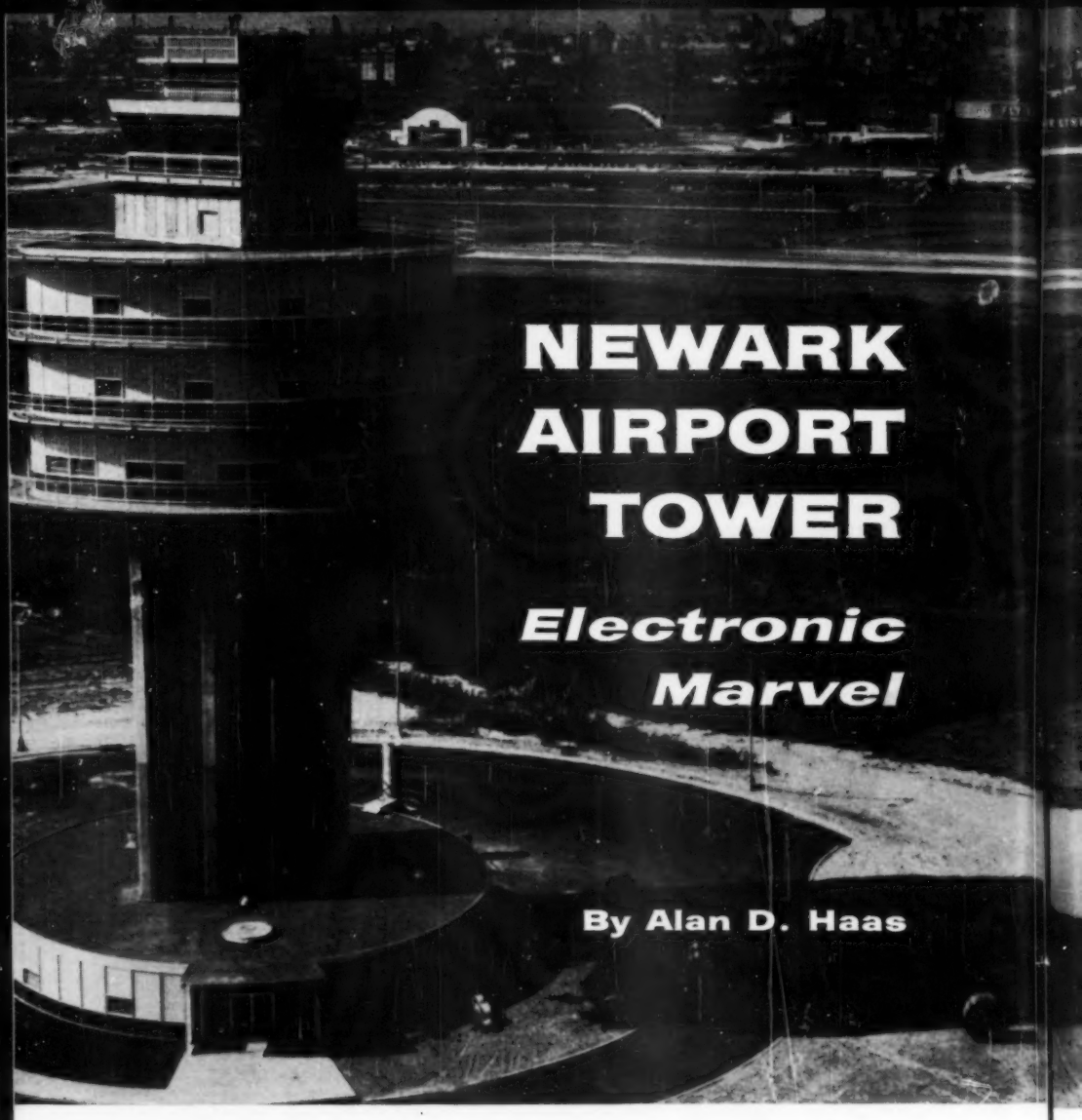


NEWARK AIRPORT TOWER

Electronic Marvel

By Alan D. Haas

WITH air traffic growing increasingly more complex in the metropolitan New York area, airports serving the city are stepping up their electronic control systems to direct incoming and outgoing aircraft. One of the three major airfields in the area, the Newark (N. J.) Airport, has just been brought into the jet age with a recently completed control tower.

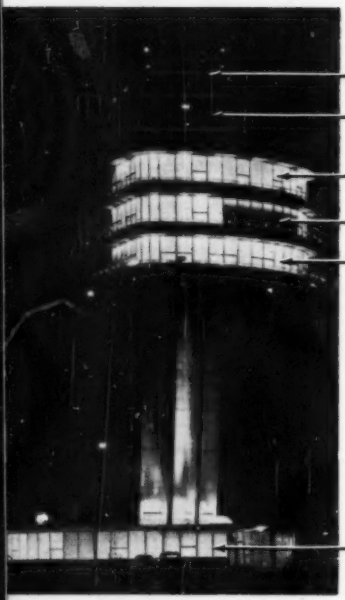
Airport taxiways and runways appear on radar screen of surface detection instrument. Screen gives the operator a comprehensive view of the entire field at a glance.

Maintenance and testing are routine operations at the Newark Airport. Engineer at right checks all tower equipment to prevent operating failures.

Traffic control position, located in control cab, is the key spot for guiding both incoming and outgoing aircraft. Cab surveys all field operations.

The tower at Newark offers the last word in jet-age equipment to the 80-odd Federal Aviation Agency specialists who staff the building. And it does everything but sit in the pilot's lap during take-offs and landings. An electronic maze of safety controls, the 150-foot ultramodern structure contains about a million dollars worth of air-traffic-control equipment—including radio transmitters and receivers, direction finders, air surveillance radar, two instrument landing systems, and a telecommunications network.

Located near the center of the 2300-acre airport between the two main runways, the tower can virtually reach into the sky and gently waft aircraft onto its runways. Once safely on the ground, the airplanes again rely on the tower to guide

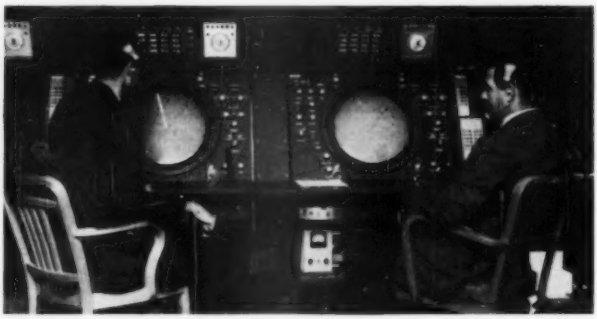


Control tower at Newark stands 150 feet high and cost 1½ million dollars to build. Federal Aviation Agency offices occupy ground floor; electronic control equipment is located on upper floors.

them back into the air en route to their next destination.

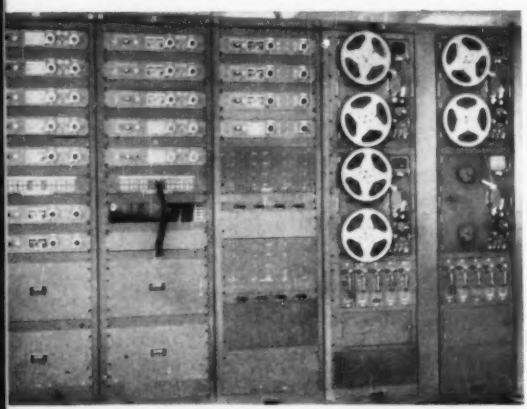
The FAA tower is as accident-proof as human electronic knowledge can make it. There are 16 radio transmitters and 13 receivers, with two separate sources of electrical power to insure continued operation in any emergency. Six different air-traffic-control radio positions are available—two in the control cab and four in the radar scope room. Located below the control cab and the radio equipment, the four radar scopes are in operation 24 hours a day.

Two of these radar scopes are used for guiding aircraft from outer fixes or holding patterns to the final approach course on the active-instrument runway. When an aircraft is about ten miles from the airport, it is picked up on a third scope which shows the craft's position on the glide path as well as its course to the



Radar scopes at right guide aircraft to final approach on instrument landing strip.

Devices in electronic equipment area include tape recorders for recording conversations with aircraft.



runway. The fourth scope is used to direct departing aircraft to a point where they have reached a specified altitude and are well on their way.

The Port of New York Authority, which operates Newark Airport, has already invested some 38 million dollars over the past ten years to improve and enlarge its facilities. And this would seem to be money well spent. During the next five years, traffic at Newark—which is the smallest of the three airports in the metropolitan area—is expected to grow from the present 15 million passengers to more than 25 million annually! -30-

POPULAR ELECTRONICS' slant on

Left to right: National NC-109, Hallicrafters SX-110, and Gonset G-43

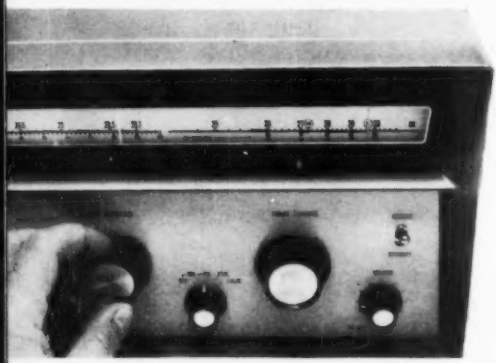
SELECTING a SHORT-WAVE RECEIVER

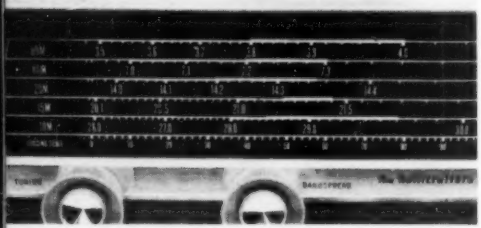
We suggest the SWL investigate advantages offered by medium-priced units

ARE you thinking of buying a new short-wave receiver? You can have a lot of fun and do a lot of DX'ing with a receiver that costs only $60. On the other hand, a very serious-minded SWL will use equipment costing $350 or more —digging for those ultra-weak short-wave stations requires topnotch precision equipment. The staff of POPULAR ELECTRONICS suggests that you investigate three receivers in the price range from $160 to $188—the Gonset G-43, Hallicrafters SX-110, and the National NC-109.

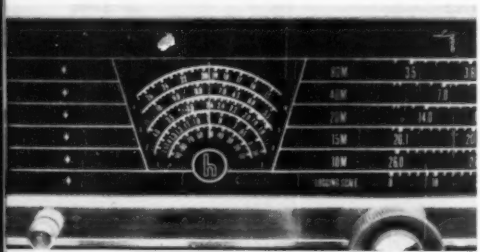
POP'tronics has purposely selected this price category since a good short-wave receiver is an investment. While we are speaking here of the SWL, each of the receivers discussed in this article has special bandspread dial calibration over the five most frequently used ham bands: 80, 40, 20, 15, and 10 meters. Thus, an SWL who later becomes a Novice or General Class radio amateur will have a receiver that is not obsolete—one which he can use for c.w., SSB, or phone operation.

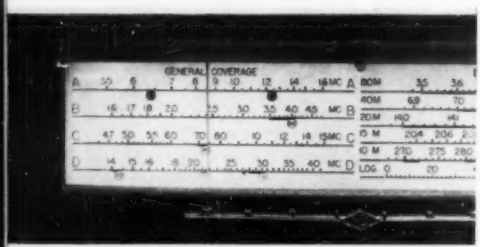
All three of these receivers have been put through their paces by the POP'tronics staff. Each is slightly different in price, circuitry, physical size, feel of the controls, etc. We recommend that, wherever possible, you investigate all of them. (You might also take a look at the Hammarlund HQ-100C, which sells for $213.95 including speaker, and the Hal-





The five most important ham bands are covered on the Hallicrafters SX-110 bandspread dial (above). Logging scale is used on the short-wave broadcast bands to separate stations. Main tuning circular dial (below) is quick-driven.





All three receivers have slide-rule style bandspread scales. The Gonset G-43 also has a slide-rule main tuning scale (left); with both scales mounted on a rotating drum, only one of the six bands is visible.

licrafters SX-108, priced at $142.90 including speaker.) Some radio stores will permit a potential customer to borrow a receiver overnight or over a weekend to try it out.

Gonset G-43. This receiver has a circuit that is comparatively unorthodox when contrasted with the other two models discussed here—it has no r.f. stage for amplification prior to the mixer stage. Instead, it counts on the high gain of three, instead of two, i.f. stages. And since the i.f. is at 1650 kc. instead of the more common 455 kc., there is almost no problem with "images." No crystal filter is used, but 12 tuned circuits in the i.f. strip shape the selectivity curve so that it seems slightly superior to two 455-kc. i.f. stages.

Performance-wise, we were impressed by the extra "length" of the main tuning range which results from spreading it over five high-frequency bands instead of the usual three. The fact that only one tuning range is visible at a time is also worthy of mention. And sensitivity was very good, with the higher frequencies (20-30 mc.) being particularly good, although a crystal filter and phasing control to remqve heterodynes was occasionally missed.

A 100-kc. crystal calibrator (Model 3269) is an optional accessory.

Hallicrafters SX-110. The use of multipurpose and high-gain tubes permits the eight tubes in this receiver to do the work of ten. The design is straight-

General-coverage dial of the National NC-109 (at left) extends from 550 kc. to 40.0 mc. The bandsetting positions are marked with small circles. This receiver has a smooth dial drive mechanism.

Important selectivity and sensitivity controls on the NC-109 (right) are conveniently grouped on one panel. The G-43 has an illuminated S-meter (below) and six separate tuning ranges.

forward and devoid of tricky circuits and unnecessary frills. In some ways—the addition of a crystal filter, for example—the SX-110 is a grown-up "big brother" of the SX-108.

Tests on the SX-110 proved that it is a capable receiver with good sensitivity and signal-to-noise ratio on all tuning bands. The main tuning dial is more rapidly driven than in either the Gonset G-43 or the National NC-109, which means that greater dependence must be placed on fine tuning with the bandspread dial. The Hallicrafters people seem to have anticipated this need and have accordingly made the bandspread coverage greater than that in the G-43 and NC-109.

National NC-109. In this receiver, 11 tubes perform the functions of 13. Of particular import is the use of independent oscillator and mixer stages said to provide greater h.f. stability and improved performance above 20 mc.

The NC-109 performed smoothly in our tests and gave the feeling of long-lasting stability. We found the four-step selectivity control in the crystal-filter circuit of great help in separating stations on the crowded 31-meter band. Available accessories for use with this receiver include a 1-mc. crystal calibrator (Model XCU-109) and a narrow-band FM adapter (Model NFM-83-50). -30-

Manufacturer	Model	Price (with spkr.)	Number of bands	Number of r.f. + i.f. stages	Crystal filter	Headset jack
Gonset	G-43	$159.50	6	0 + 3*	no	rear
Hallicrafters	SX-110	$172.90	4	1 + 2	yes	front
National	NC-109	$187.50	4	1 + 2	yes	front

* see text

The ABC's of the QSL

A "reward" for service rendered, the QSL is a colorful memento of an exciting hobby

By HANK BENNETT
W2PNA/WPE2FT

SHORT-WAVE LISTENING is often considered a hobby in which communication is only one way—incoming. This is true to a certain extent, but there is an interesting sideline to it that we would like to tell our readers about, especially those who are new to the hobby or who have not yet become SWL's. This sideline deals with reporting to the stations heard, and receiving their verifications—or QSL cards.

Every day hundreds of short-wave broadcasting stations are on the air beaming programs in a multitude of languages to other countries around the world. Many of these stations—located anywhere from London to Rio de Janeiro, from Tokyo to Moscow—beam regular broadcasts to North America. Some have their own monitoring stations in the U.S.A., but others depend on reports from listeners for information as to whether their signals are being received loud and clear, or poor and weak.

Service Rendered. The newcomer to the hobby may find it interesting and informative to tune in foreign English-language newscasts or to relax to the splendid musical programs offered by many stations. But it doesn't end there—the stations would like to hear from you. They are interested in knowing how well you can hear them and how much you like (or dislike) certain programs. They also want to know whether other stations are interfering with their signals.

The information that you give the stations will help them determine if it is necessary to change frequency in order to avoid interference with other stations. It will enable them to know which of their programs listeners feel are the most interesting. It will also provide them with a definite key as to whether their broadcast times are good or whether they should be adjusted to furnish better reception for more listeners.

Typical Report. To make your report of greatest value to a station, there are certain things you should include in it. First, give the name of the station heard

(either the call letters or station slogan), your location (city and state), and the frequency to which your receiver is tuned.

Then list the exact times at which you heard the station, and be sure to give your time zone (EST, PST, etc.), or give the time in GMT if you wish. List all the program details that you hear with corresponding times for each item, e.g., 0855 news in Eng., 0859 station announcement, 0900 time check, 0900-0915 dance music (and name some of the selections played if you know them.)

Be sure to state how well you hear the station. If there is interference or fading, say so.

You might also mention the make and model of your receiver, the type of antenna you are using, the weather at the time of reception, and your location with respect to some nearby large city.

It is always best to put your report into letter form. Some listeners prefer to send reports on post cards—such reports rarely contain enough information to be of use to stations. Your letter should be thorough and complete, but avoid repetition. Be accurate, though, and be honest in your overall evaluation of the signals.

Verifications. When you want a station to reply to you and to verify your report (many SWL's avidly collect QSL's from stations the world over), enclose return postage and respectfully ask the station to verify if your report is found to be correct. In reporting to foreign countries, your best bet is to enclose an International Reply Coupon (several if you want your reply by airmail). These coupons are available at most post offices for 15 cents each.

Don't be impatient if the stations do not reply at once. Your letter will be only one of many that they receive, and it takes time for them to check the reports against their logs. And do not feel that one report per station is all that you can send; perodic reports will always be welcomed for they will help the stations to know whether their signals are better or worse than before.

Above all, remember that how fast you receive a reply may depend on how much a station values your report. Make your reports informative, and before long those QSL's will be pouring in. -30-

ADDRESSES OF FREQUENTLY HEARD SHORT-WAVE BROADCASTING SERVICES

British Broadcasting Corp.
Broadcasting House
London, W. 1, England

Cairo United Arab Republic Broadcasting Service
4 Sherifein St.
Cairo, U. A. R.

Canadian Broadcasting Corp.
P. O. Box 6000
Montreal, Quebec, Canada

Czechoslovak Radio
Praha-12, Stalinova 12
Czechoslovakia

ELWA Radio Village
Box 192
Monrovia, Liberia

New Zealand Broadcasting Service
P. O. Box 98
Wellington, New Zealand

Nippon Hoso Kyokai (Radio Japan)
No. 2, 2-chome, Uchisaiwai-cho
Chiyda-ku, Tokyo, Japan

The People's Republic of China
Broadcasting Administration
Outside Fu Hsing Men, Peking

Radio Moscow
Pjatnitskjaja ulitza 25
Moscow, U. S. S. R.

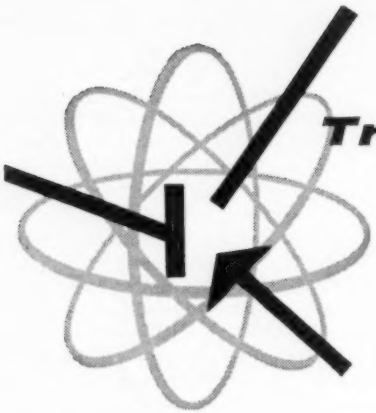
Radio Nacional de Espana
Paseo de la Castellana, No. 42
Madrid, Spain

Radiotelevisione Italiana
Via del Babuino 9
Rome, Italy

Voice of America
Washington 25, D. C.

The Voice of Germany (Deutsche Welle)
Postfach 344
Cologne, Germany

The services listed above are only a few of those on the air. Many others from countries all over the world are listed in the World Radio Handbook, available from Gilfer Associates, P. O. Box 239, Grand Central Station, New York 17, N. Y., for $2.70 per copy.



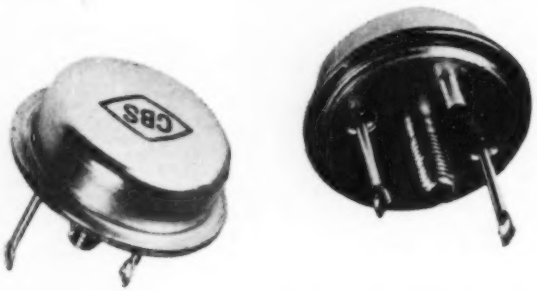
Transistor Topics

By LOU GARNER

ONE of the pleasant tasks faced each year at this time is a guessing game we play with the semiconductor industry. Yours truly attempts to foresee the new developments to be introduced in the coming year. The industry, in turn, creates products which exceed anything conceived in the wildest flights of imagination.

In 1960 blurred images in the crystal ball revealed an American satellite circling the moon and carrying transistorized instrument packages—*negative double-check*—our roman candle experts failed to orbit the moon with a satellite. However, tubes were abandoned after the last few earth satellite shots. Not only are the instrument packages completely transistorized, but the command receiver and transmitter sections use transistors exclusively. Considerable output power can now be obtained from transistors. . . . Two-way radios for foot patrolmen were anticipated—*partial check*—several cities are experimenting with transistor *paging receivers* for their officers. They can hear the police calls on their private radio receivers, and if their services are required, they simply telephone the station house for more information.

The prophecy of a transistorized "hybrid" FM receiver for automobiles registered with a thud, a possible reason being the popularity and acceptance of similar receivers which *translate* the signal from the FM band to the standard AM auto radio. The introduction of many new AM-FM portable radios, including a domestic version by Zenith, may have slowed the production of FM auto radios; many of these inexpensive compact portables are used in place of regular car radios. . . . Transistor ignition systems did not achieve wide acceptance. However, alternator generator systems, using silicon rectifiers to convert the a.c. to d.c. suitable for charging the battery, are standard on several models and optional on almost all other automobiles. . . . The vague outline of a semiconductor picture tube for television receivers was seen in the crystal ball—*check*—Sony of Japan announced experiments on such a device in 1960.



A series of 85-watt power transistors (TO-36) has been introduced recently by CBS Electronics. One such unit can replace two 40-watt or four 20-watt paralleled transistors.

Our prediction of low-priced experimenter v.h.f. power transistors was realized—*check*—the Motorola 2N711 and 2N741 are bargain-priced and go up to

several hundred mc. Texas Instruments "grade out" Types S-065 and R-425 are also extremely popular. In the moderate power class—*check*—Rheem, PSI, and others make two-watt silicon mesa 50-mc. transistors for less than $10.00. . . . Fully transistorized Citizens Band radiotelephone equipment was foreseen—*double-check*—RME, Electra, Karr, Morrow, Globe, Osborne, and many others have marketed "pocket-sized" two-way transistor transceivers which require no license of any sort. . . . Another touchdown was scored in predicting transistorized control devices for the home—*double - check* — garage door openers abound, and several companies, among them F & M Electronics, build an eight-channel completely transistorized model airplane radio-control system.

Things to Come. Moving out on our well-worn limb, saw in hand, we look forward to seeing in 1961 a race among manufacturers of Citizens Band equipment to introduce more powerful, completely transistorized walkie-talkie pack sets. . . . at least one company will produce a CB transceiver with one-watt power input which will operate from rechargeable batteries. . . . more amateur-radio equipment, particularly single-sideband transmitters, will employ transistors. . . . amateurs and experimenters can expect to obtain "grade outs" of silicon mesa two-watt r.f. transistors for three dollars, or less. . . . model airplane radio-control equipment will swing almost completely to transistors, a fact that will permit at least 20 more R/C channels to be added . . . hi-fi equipment will become more dependent on transistors, particularly in low-noise preamplifier applications.

Transistor CB Transmitters. One of the most interesting developments to come out of 1960 is the advent of ultra-compact Citizens Band transceivers. These units are designed to comply with Part 15 of the Federal Communications Commission Rules and Regulations which permits the operation of *unlicensed* low-power radiotelephone equipment in the 27-mc. Citizens Band. The transmitter power amplifier stage must run less than 100 milliwatts input (100 milliwatts is the same as 0.1 watt), and the antenna length cannot exceed five feet.

Many companies have jumped on the "band-wagon" to produce equipment for this short-range (about 1 mile) communications service for hunters, construction workers, traffic controllers, etc. And experimenters can build their own equipment if they are technically qualified to determine whether the transmitter complies with Part 15.

At least one manufacturer, International Crystal Mfg. Co., Oklahoma City, Okla., is producing printed-circuit transmitter kits to comply with Part 15. Although the TRT-2A transmitter was originally intended for use in this company's transistor transceiver, experimenters can purchase the transmitter separately, wired or in kit form. The circuit is shown in Fig. 1.

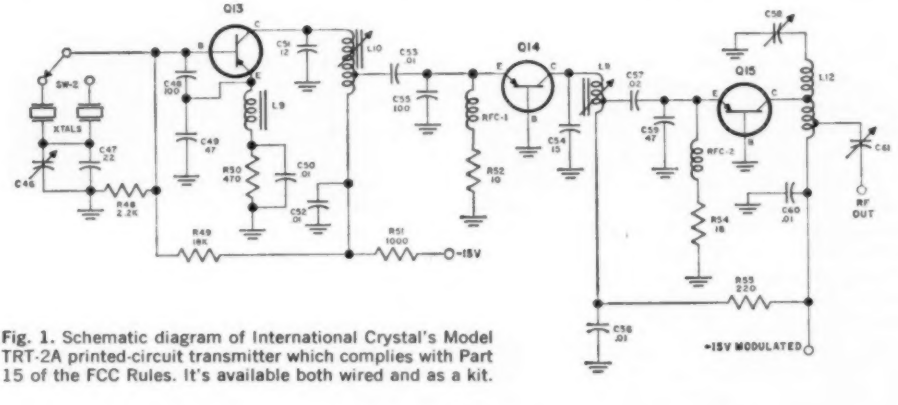


Fig. 1. Schematic diagram of International Crystal's Model TRT-2A printed-circuit transmitter which complies with Part 15 of the FCC Rules. It's available both wired and as a kit.

Model TRT-2A is capable of two-channel operation if you switch the proper

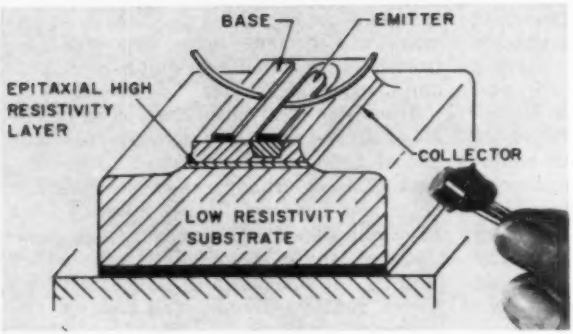


Fig. 2. The addition of an "epitaxial" layer to an otherwise ordinary transistor results in much higher output with increased efficiency. Typical units deliver ½ watt at 70 mc.

crystal into the circuit. A padder capacitor in series with the crystal adjusts the transmitted frequency "on the money." The common emitter oscillator (*Q13*) is a specially selected Texas Instruments Type S-065.

The oscillator circuit is somewhat unusual in that the crystals used are 13.5-mc. fundamental types and the circuit doubles the frequency to 27 mc. The r.f. energy appearing across coil *L10* is coupled to transistor *Q14*, which acts as a buffer-amplifier and is connected in the grounded-base arrangement. The stage receives its forward bias by rectifying some of the r.f.

A grounded-base power amplifier (*Q15*) receives its bias in the same manner, and serves to step the signal level up to the 100-mw. level. Coil *L12* is used to match the power amplifier transistor collector impedance to the antenna or transmission line. If *Q15* is replaced with a Texas Instruments 2N1143, the unit is capable of several hundred milliwatts of power input, and, of course, increased power output.

The International Crystal circuit uses an extra transistor so that it can also be employed in other high-power applications.

Epitaxial Transistor. A radically new method of producing transistors was announced by Bell Telephone Laboratories in June of 1960. Since that time Motorola, Sylvania, Rheem, and others have been producing the "Epitaxial Mesa" transistor in engineering quantities. The devices represent a breakthrough for they are a realization of what has, to now, been only theoretically possible.

Epitaxial transistors consist of thin semiconductor layers epitaxially (derived from the Greek word for "settling on") deposited on low-resistivity substrates or bases of germanium. See Fig. 2. The performance of these units is far superior to conventional germanium mesa transistors.

The epitaxial transistors combine the high reliability, power dissipation, and switching speed of the mesa transistors with the low saturation resistance which has come to be associated with high-frequency alloy-type units.

In amplifier circuitry, the new devices are capable of delivering much higher power output, at higher levels of efficiency. Because they present practically no series resistance in the circuit, there is considerably less power loss in the collector. Typical units are capable of delivering one-half watt of power output with 10-db gain at 70 mc.

The prices for these devices are expected to be substantially the same as for regular mesa transistors. The Motorola Type 2N834 is priced at $18.00 each in original equipment manufacturer quantities. An epitaxial version of the 2N705 germanium mesa transistor is also available at a reduced price.

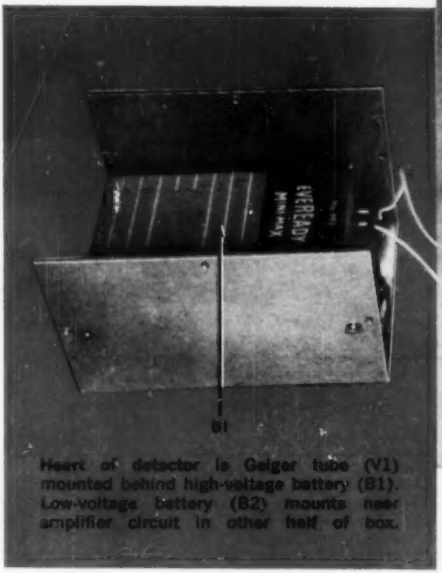
Product News. CBS Electronics' Semiconductor Division (Lowell, Mass.) has announced a new 85-watt *p-n-p* power transistor which saves space and weight and reduces cost. It can be used to replace two 40-watt or four 20-watt paralleled transistors. The nine types in this high-power class are the 2N173, 2N174, 2N277, 2N278, 2N441, 2N442, 2N443, 2N1099, and the 2N1100. These devices can provide 30 watts in Class A, 100

(*Continued on page* 118)

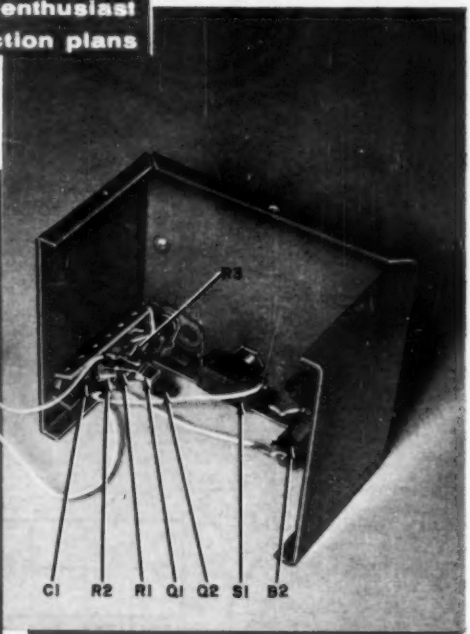
ADVANCED EXPERIMENTERS CORNER

Proven circuits for the electronics enthusiast who does not require construction plans

RADIATION DETECTOR

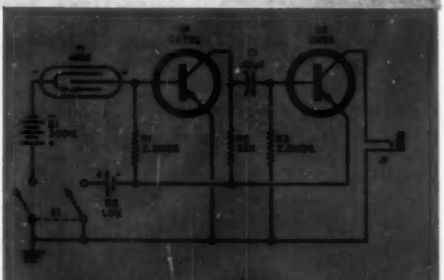


Heart of detector is Geiger tube (V1) mounted behind high-voltage battery (B1). Low-voltage battery (B2) mounts near amplifier circuit in other half of box.



DESIGNED to detect gamma rays, this instrument uses a 1B86 Geiger tube and a transistorized amplifier feeding magnetic phones. Dubbed the "Trans-Geiger," it has built-in high and low voltage batteries, making it completely portable. Current drain is so low that both batteries have normal shelf life.

The pulse amplifier circuit incorporates two transistors (*Q1* and *Q2*) and uses 2.2-megohm base bias resistors (*R1* and *R3*). Thus, the transistors are Class B operated, reducing collector current to less than 50 microamperes. Similarly, drain on battery *B1*, in series with Geiger tube *V1* and resistor *R1*, is well under 1 ma. Switch *S1* is included in



PARTS LIST

B1—300-volt battery (Burgess U200, Eveready 493, or RCA VS093)
B2—1½-volt flashlight cell
C1—0.01-μf. disc capacitor
J1—Open-circuit phone jack
Q1—CK722 p-n-p transistor
Q2—2N35 n-p-n transistor
R1, R3—2.2-megohm, ½-watt resistor
R2—33,000-ohm, ½-watt resistor
S1—D.p.s.t. toggle switch
V1—1B86 Geiger tube
1—5" x 4" x 3" aluminum box (Bud CU-2105A or equivalent)
Misc—Hardware, terminal strips, flashlight cell holder, etc.

the circuit to protect the batteries should the sun's heat cause *Q1* or *Q2* to develop excessive leakage current when you're out prospecting.

Construction. The Trans-Geiger will fit in a 5″ x 4″ x 3″ aluminum box with just enough room to spare. Mount the 300-volt battery (*B1*) and the Geiger tube (*V1*) in the back half of the box. Be careful when handling and mounting the Geiger tube, since it is extremely fragile. The tube is mounted to the box by gluing it to a pair of ½″ cubes of sponge rubber; do *not* use metal clamps to mount the tube. Since the 1B86 is a gamma-ray detector, and gamma rays are not stopped by thin sheets of aluminum, there is no need to cut a window for it in the aluminum box. Battery *B1* should be strapped in place to prevent it from moving and damaging the tube.

All other components are mounted in the cover half of the box; locate them so that they don't jam against *B1* or *V1* when the box is closed. The pulse amplifier circuit is wired to a pair of 6-lug terminal strips. Mount headphone jack *J1*, switch *S1*, and the battery holder for *B2* on one of the 5″ sides of the box; this puts *J1* and *S1* free and clear of the carrying handle. As a finishing touch, cement a thin layer of sponge rubber to the bottom of the box to act as a shock absorber.

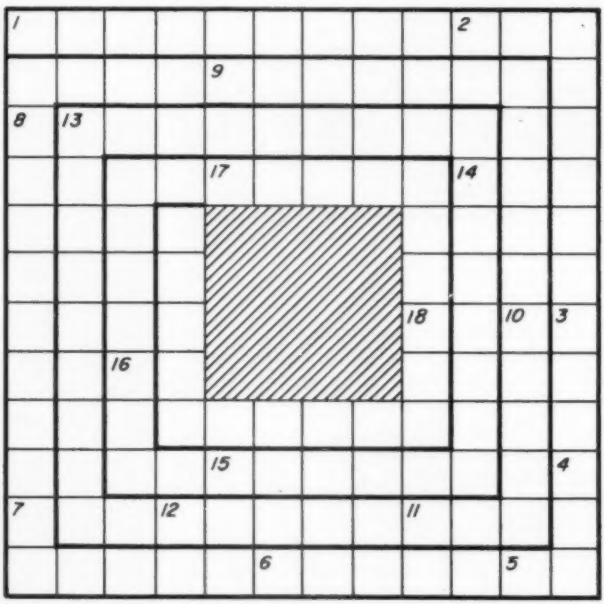
Operation. Plug in a high-impedance magnetic headset and flip on switch *S1*. You will hear some random clicks due to an occasional spurt of cosmic rays hitting the Geiger tube; natural background radiation might also contribute a few clicks. Now lower the bottom of the Trans-Geiger to a radium dial watch; the clicking rate will increase, indicating the presence of a radioactive material which generates gamma rays. In checking radioactive ore samples, use the radium dial watch as a standard—the more clicks per minute, the more radioactive the sample.

—*J. E. Pugh, Jr.*

ROUNDWORD PUZZLE

By Leonard I. Kindler

Here's a puzzle to warm the heart of any electronics experimenter. If you're up on your theory, this one should be a cinch! If you're not, there may be some rough going in spots. Just start in the upper left-hand corner and work clockwise until you reach the center. The last letter of each word is used as the first letter of the next word, and the first word begins with a "T."



1 Detects temperature changes.
2 _____ impedance is caused by load on other side of transformer.
3 Capacitor construction type.
4 Interconnecting wire.
5 _____ waves progressively decrease in amplitude.
6 Unit for expressing power ratio.
7 Wave pattern seen on oscilloscope.
8 Wire joint.
9 Detects static charges.
10 Part of a tube.
11 Switch design type.
12 Capacitor discharge curve type.
13 Piece of transformer core.
14 _____ voltage is fed in 180° out of phase with r.f. signal.
15 Band between adjacent FM channels.
16 Speaker or mike type.
17 Oscillator using parallel-tuned tank.
18 Superregenerative detector type: hyphenated word.

(Answer on page 115)

On the Citizens Band

By TOM KNEITEL, 2W1965

READERS often write to ask why we don't run technical gems in this column. The reason is simple—a lot of space is needed to do justice to most technical subjects, and until recently we didn't have it. But now, thanks to our expanded CB coverage, we hope to present not-too-involved technical items with some frequency (no pun intended). This month we'll start out by talking about mobile antenna mounting, and we'll wind up with some tips on antenna impedance.

The most practical place to locate a mobile antenna on a car is on the left rear fender at about bumper level. Unfortunately, though, the most practical antenna location isn't the spot where you're going to radiate the best non-directional signal.

When you mount your antenna on the rear of the car, you are in effect, using the car as a counterpoise, or ground plane, which gives you a 6-db signal gain in the area in front of the car on the side opposite the antenna. (A 6-db gain means that your signal is increased almost four times.) On the side where the antenna is located, you'll have a 6-db attenuation, however, or one-fourth the signal you would have with a non-directional antenna. An improvement of 50% in range and signal strength is possible when the body of the car lies between the antenna and the stations contacted.

Obviously it will be to your advantage to mount the antenna so that portions of the car will extend in all directions around it, i.e., in the exact center of the roof. Where a bumper-mounted antenna might give, say, 5 miles range towards the rear of the car and 7½ towards the front, a roof job would presumably give up to 7½ miles in all directions.

Don't be too concerned about the height of roof-mounted antennas, incidentally—some of the shorter units do just as well as the longer ones and give no trouble with trees, garage doors, and the like. A spring base is usually provided on roof-mounted jobs, and shorter Fiberglas whips, like the "Heliwhip," are often used to cut down on height. A "Heliwhip" for CB is only 48" long, compared to 108" for a standard steel whip. But don't confuse these whips with the base-loaded "portable" whips (40" long, metal, with vinyl covered coils at the bottom), which do not give full range.

Station efficiency is something dear to the hearts of all CB'ers. It should be, because unless your station is efficient, you won't stand much chance of plowing through the 11-meter garble.

But how do you know how well you are "getting out?" Your friends can give you their opinions, but the best way to "psychoanalyze" your rig is with an "FSM," more properly known as a field strength meter. One recently developed unit which offers more than most is the Philmore FS-1. It needs no physical connection to your rig to tell you what kind of signal you're putting out, and a flip of one of the switches

on the front panel turns the unit into a wattmeter for measuring the actual output in watts at your transmitter's antenna jack. Another switch selects either a 52- or 75-ohm load, and the device is furnished with a special interconnecting cable for use in the wattmeter hookup. The FS-1 sells for only $17.50 in easy-to-build kit form.

Many hundreds of mobile units throughout the country are now sporting the snazzy red, white, and blue Five Watt Wizard decals. These 3½" decals are available only to Five Watt Wizard members from club headquarters (P. O. Box 203, Forest Hills 75, N. Y.) for 50 cents each. There's a space on the bottom of the decal for your call sign.

Incidentally, the Wizards recently accepted an application from the "Jersey 5 Watters" (a New Jersey club) to become an independent affiliate of their organization. Other clubs, as well as individuals, are welcome to write to the Wizards at the above address for information on affiliation with the nation's largest non-profit CB organization.

Letters from CB'ers all over the country are asking "What's this 'impedance' nonsense with antennas?" Actually it's far from nonsense, so let's take a good look at it and see what antenna impedance is all about.

Every antenna has a characteristic "impedance" which must be borne in mind when putting it to use. Most CB antennas have impedances of 50 to 53 ohms or 73 to 78 ohms, and the coaxial cables which feed the signal from the rig to the antenna must be rated at the same impedance as the antenna to insure maximum signal transfer. Therefore, the coax feeder lines most commonly used by CB'ers are the inexpensive RG-58/U (53.5 ohms) and RG-59/U (73 ohms).

One interesting fact many CB'ers seem to be unaware of is that the longer the stretch of coax between rig and antenna, the weaker the signal by the time it reaches its destination. On a 100′ cable run using RG-58/U or RG-59/U, you lose about half of your output power by the time it gets to the antenna.

The remedy is to use a larger diameter cable of the same impedance, assuming you have a long cable run. While large-diameter coax is more expensive than small-diameter cable, it has considerably lower loss than its smaller brothers. A good substitute cable for 52-ohm antennas is RG-8/U, which will dissipate only 22% of your signal power every 100 feet, or RG-17/U which will cut the loss down to 15% every 100 feet. For 75-ohm antennas, RG-11/U is best—like RG-8/U, it has a 22% power loss.

As an example, let's say your transmitter operates at 80% efficiency (and I'll bet a penny that it's even less). At 80% efficiency, you're probably getting about 4 watts *output* at your rig's antenna jack. With 100 feet of RG-58/U cable, you would have about 2.2 watts delivered to the antenna. With RG-8/U, you'd have 3.1 watts, and with RG-17/U there would be 3.4 watts. An extra watt and a fraction can mean a lot on the Citizens Band. Of course, there are better cables to use than RG-17/U, but you'd have to be King Midas to afford 100 feet of the stuff.

The table below lists types of cable suitable for CB use, together with their characteristic impedances, db losses, and % power loss per 100 feet. Values are approximate since slight differences occur in manufacturing and between different manufacturers' units. —30—

COAXIAL CABLE	IMPEDANCE IN OHMS	DB LOSS PER 100′	POWER LOSS PER 100′ (%)
RG-8/U	52	1.1	22
RG-8A/U	52	1.1	22
RG-11/U	75	1.1	22
RG-11A/U	75	1.1	22
RG-17/U	52	0.7	15
RG-17A/U	52	0.7	15
RG-58/U	53.5	2.6	45
RG-58A/U	50	2.6	45
RG-58C/U	50	2.6	45
RG-59/U	73	2.6	45
RG-59B/U	75	2.6	45

Across the Ham Bands

By
HERB S. BRIER
W9EGQ

ZERO-BEATING AND STABILIZING TRANSMITTERS

HOW OFTEN have you heard a CQ from a state you needed for your WAS, frantically answered his CQ on what you believed to be the same frequency, then waited only to find he was talking to someone else? Similarly, when you're roaming around the bands, you probably often pick up a rare DX station working local stations in sequence on a single frequency, and afterwards hear a number of the locals answering him on different frequencies—sometimes the locals calling the original DX station are so far removed from his frequency that they reduce their chances of being heard to virtually zero.

The culprit is frequently operating technique, but at times your rig may be the offender. If all ham transmitters and receivers were precisely calibrated, transmitting and receiving on exactly the same frequency would require simply matching transmitter and receiver dial settings. As few ham sending and receiving rigs are calibrated with this degree of precision, zero-beating is the best way to hit the right frequency.

How to Zero-Beat. The basic method of zero-beating *phone* stations is to tune in the desired signal on your receiver with the BFO off. Then, without disturbing the receiver settings, turn on the low-power stages of your transmitter and tune the transmitter's VFO until you

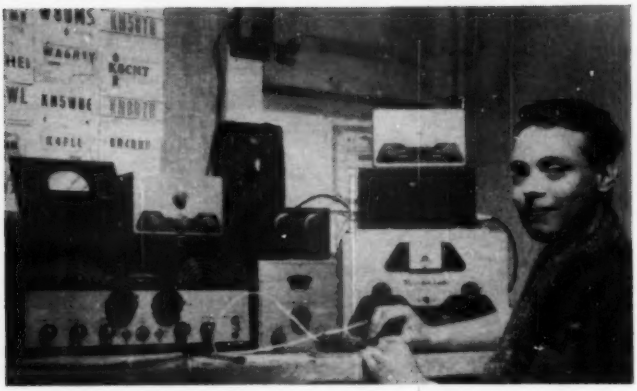
Ham of the Month

Rx: DX is the prescription that Harold H. Riker, M.D., Flushing, N. Y., wrote for himself about six years ago. Under the call letters K2JHA, he takes the medicine it specifies—large doses of ham radio—before meals, after meals, and any other time that he can spare from his busy practice.

Dr. Riker's ham station contains a kilowatt transmitter feeding a three-element tri-band rotary beam on 10, 15, and 20 meters, and a trap antenna for use on 80 and 40 meters. On top of the beam is a neat little two-meter vertical antenna which is connected to a Gonset "Communicator" that Dr. Riker uses for local work.

When asked facetiously if all his fancy equipment worked, "Doc" snapped a few switches, and within two minutes was talking to ZS6KD in Johannesburg, South Africa. Then, in rapid succession, G2MA, Yorkshire, England; W2CMM, New York City; and PZ1AX, Surinam, South America, joined in.

Not a man to be separated from his hobby simply because he must call on patients and visit hospitals, K2JHA has a five-band mobile station in his car. He also uses a CB transceiver on the road to keep in touch with his office.



Curt, WV2MZP, (above), occupies the shack of his brother, Doug, WA2JRQ, who is in the Air Force. A third brother, Tom, WV2MZL, also operates the same rig sometimes.

Bill, K7KST, who operates in Seattle, Wash., worked 30 states on 40 meters in only five months as a Novice—all call areas.

hear a high-pitched whistle from the receiver. This whistle is an audio tone resulting from the mixing of the received frequency with your transmitter's frequency. As you continue tuning the transmitter's VFO, the frequency of the "beat" note will decrease to zero and then increase again. At the zero-beat point, your transmitter and the incoming signal are on exactly the same frequency.

To zero-beat a *c.w.* signal, set up the receiver for c.w. reception and tune in the desired signal in the normal manner. Then, turn off the receiver BFO and zero-beat the transmitter to the signal as described for phone operation, above. Now turn the BFO back on. If you have done the job correctly, the beat note formed by your transmitter's signal will have the same pitch as the one generated by the incoming signal.

In order to obtain an accurate zero-beat between two signals, they should be approximately the same strength. Otherwise, the stronger signal will swamp out the weaker one, thus obscuring the exact zero-beat point. A highly selective receiver with good overload characteristics will decrease this effect somewhat, but the real solution is to decrease the strength of the transmitter's signal by turning on only its low power stages. A good operator would do this anyway, because swishing a transmitter across the bands at full power to zero-beat a signal creates unnecessary interference.

Unfortunately, some transmitters don't have any provision for turning on their low power stages without turning on the final amplifier. Our construction project this month shows how this provision can be added to a transmitter.

Increasing Stability. Sometimes, no matter how carefully you set your transmitter oscillator on the frequency of another station, when you switch on the transmitter's final, you discover that you are no longer on exactly the same frequency. One cause of this is poor power-line regulation. The added load of the final decreases the line voltage a few volts, and this in turn reduces the oscillator tube filament voltage, causing your frequency to shift. Check this possibility by observing your VFO frequency when you plug an electric iron into the same line that powers your transmitter. You can sometimes minimize this effect by operating the oscillator tube from a separate filament transformer plugged into a different outlet from the one employed to power the other circuits in the transmitter.

Turning on the buffer, multiplier, or final stages may also pull the oscillator frequency in some transmitters even when all voltages remain constant. This is common in the surplus "Command Set" transmitters (BC-459's, ARC-5's, etc.) that some hams use as VFO's or as complete transmitters. You can overcome this defect by determining how much you have to turn the oscillator dial to compensate for it—usually about half a dial division—and offset the dial this amount after zero-beating a frequency with only the oscillator on.

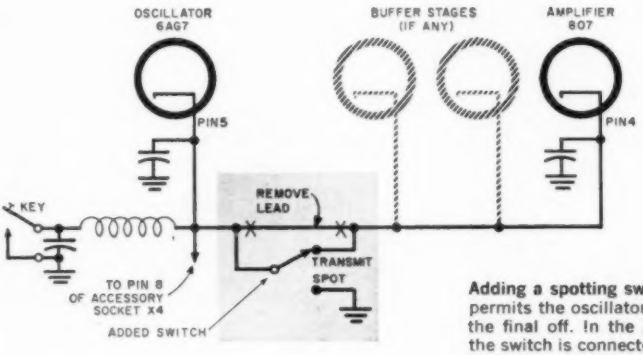
"SPOTTING" SWITCH

Many low-powered c.w. transmitters incorporate simultaneous keying of both the oscillator and final cathode circuits. Although this type of keying usually works quite well, there is often no way to turn on the oscillator and keep the final off. With the oscillator on by itself, you can get a more accurate "spot" of your frequency on your receiver and have a low-level signal for zero-beating a station calling CQ.

According to Howard S. Pyle, W7OE, it is a simple task to add a frequency-spotting switch to a transmitter. The diagram below shows how to add such a switch to the Johnson Adventurer transmitter, but it should apply equally well to other cathode-keyed transmitters.

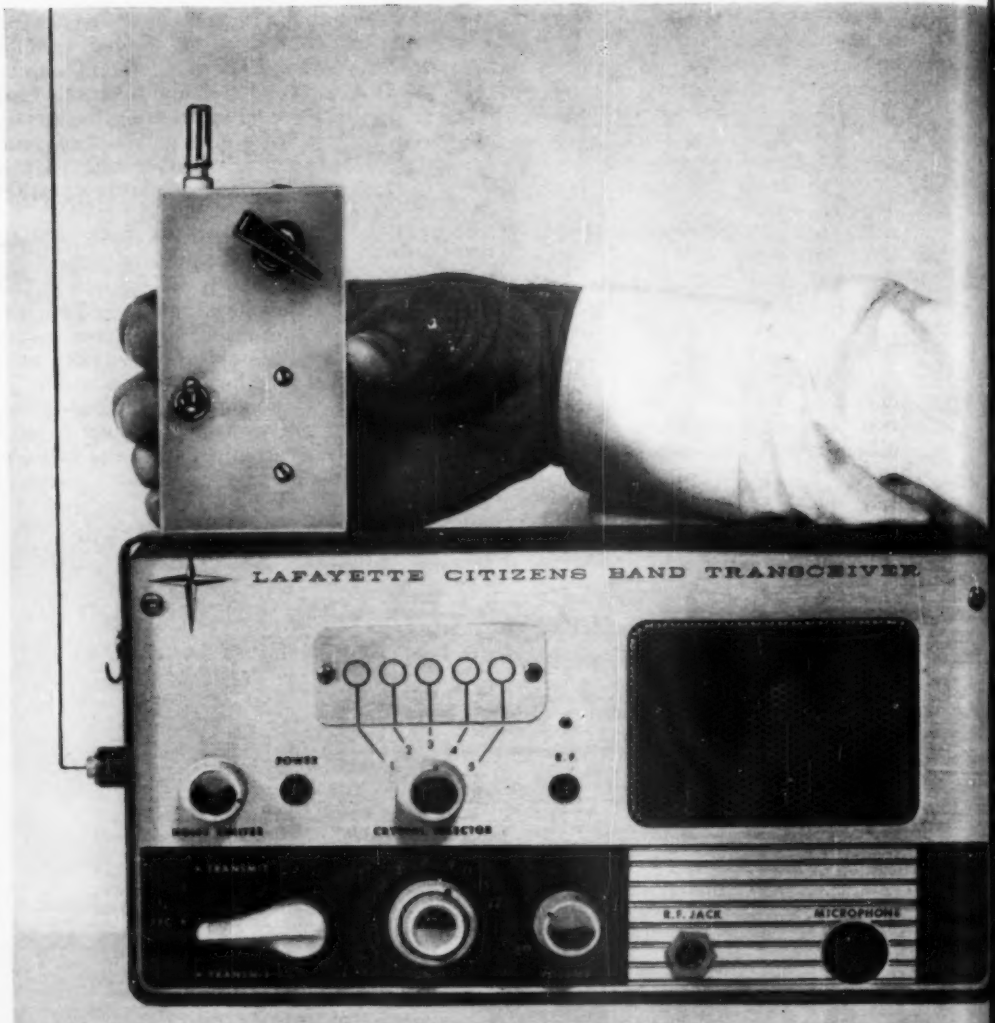
Mount a single-pole, double-throw switch on the transmitter panel in any convenient location. Connect the switch's arm to the key circuit and also to the oscillator cathode. Then connect one fixed switch terminal to the cathodes of the final and any other intermediate stages; ground the remaining switch terminal to the transmitter chassis.

Throwing the switch to the ground position will operate the oscillator alone; the other switch position will provide normal operation of the transmitter. In addition to making it easier for you to zero-beat your transmitter, this switch will win you the gratitude of other amateurs by reducing an unnecessary type of interference.



Adding a spotting switch to a transmitter permits the oscillator to be operated with the final off. In the Johnson Adventurer, the switch is connected between the 6AG7 and 807 tubes, as shown in the diagram. With other rigs, insert the switch in front of existing buffer or multiplier stages.

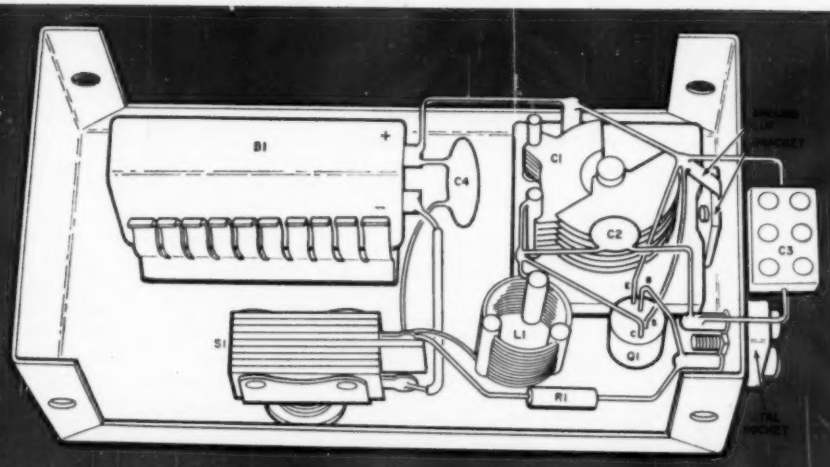
(*Continued on page* 114)

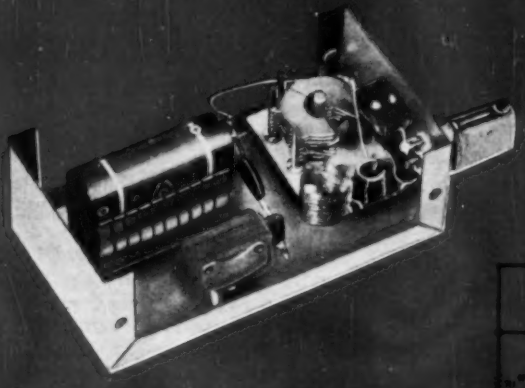


CB CHANNEL SPOTTER

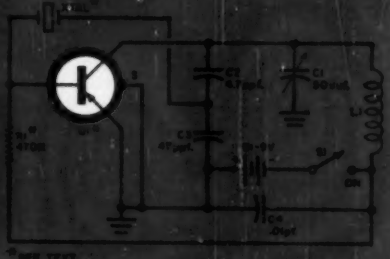
Handy home-built calibrator pinpoints operating frequency on tuning dial

By DONALD L. STONER, W6TNS





Follow the parts layout shown here as closely as possible to minimize changes in stray capacitances.



THE INCREASING USE of tunable receivers in the Citizens Band calls for a device to "spot" your frequency on the receiver tuning dial. Just in case you're not crystal-controlled on the *receive* channel, it's handy to have a gadget that will show the exact setting when the channel is unoccupied.

The "CB Calibrator" will do just that. Essentially, it is a low-power crystal-controlled transistor oscillator for the Citizens Band. When a (transmitter crystal for your CB rig is placed in the calibrator's crystal socket, the instrument will generate a signal on the appropriate channel. When accurately calibrated CB crystals are used, the signal should be within the 0.005% limits specified by the FCC for CB equipment.

Using all new parts, you should be able

PARTS LIST

B1—9-volt transistor battery
C1—50-μμf. variable capacitor (Hammarlund HF-50 or equivalent)
C2—4.7-μμf. NPO disc or silver mica capacitor
C3—47-μμf. NPO disc or silver mica capacitor
C4—0.01-μf. disc ceramic capacitor
L1—11½ turns of No. 15 wire, air core (B & W 3003 or equivalent)
Q1—2N274 drift transistor—see text
R1—½-watt resistor—see text
S1—S.p.s.t. toggle switch
1—4½" x 2⅛" x 2⅛" chassis box (Bud CU-2116A or equivalent)
Misc.—Crystal socket, battery holder, solder lug

to construct this handy little calibrator for less than $8.50.

Construction. The unit is housed in a 4¼" x 2¼" x 1½" aluminum box. The only other components required are a few capacitors, a resistor, one transistor, a coil, a battery, a switch, and a crystal socket.

Mount the tuning capacitor (*C1*) by its shaft nut and a screw through its bracket. A solder lug placed between the chassis and *C1*'s bracket serves as a common ground for the entire unit. The crystal socket is mounted alongside the tuning capacitor. Transistor *Q1* and coil *L1* are held in place by their leads with no other external support.

Most of the space in the box is taken up by the battery and switch. They may be mounted wherever convenient. The battery is wired directly into the circuit. Also wire in the three fixed capacitors (*C2, C3* and *C4*), keeping their leads as short as possible. Do not wire in resistor *R1* until after the adjustments are made.

Adjustments. There are just two adjustments needed to put the calibrator in operating condition. The first is to set the transistor's collector current at about 0.4 ma.; the second, to set *C1* properly.

The author used an RCA 2N274 drift transistor. Another transistor in the same family (such as the 2N274, 2N370, 2N371, or 2N372) can be used if you wish. Some of these transistors will oscillate while drawing as little as 0.1 ma.; others may need as high as 0.5 ma. With the minimum drain (0.1 ma.), the battery should last almost its entire shelf life. With a drain of 0.4 ma., the battery will last six months to a year under normal service.

Connect a 1-ma. milliammeter in series with one of the battery leads. Substitute a 1-megohm potentiometer (wired as a variable resistor) for *R1*. With the pot at maximum resistance and no crystal in the socket, turn on the switch. The meter should read zero. (Current is actually less than 1 microampere.) Decrease the pot's resistance until the meter reads about 0.2 ma.

Insert a crystal in the socket and slowly tune *C1* while listening for the signal on your CB receiver. If the unit is oscillating, remove the pot, measure its resistance, and place a fixed resistor with the same value (or as near to it as possible) in the circuit. If the calibrator is not oscillating, decrease the pot's resistance a little more and try again. The unit should "take off" with less than 0.5-ma. collector current.

Only third-overtone crystals intended for the Citizens Band are suitable. Fundamental-type crystals will *not* work in this circuit since they operate at a low frequency that is later multiplied to a CB channel frequency.

Operation. To use the calibrator, simply place a CB third-overtone crystal in the socket and flip on the switch. Normally, capacitor *C1*'s plates will be about one-quarter meshed and will need no readjustment (unless crystals for widely separated parts of the band are used).

The calibrator's high degree of accuracy enables it to be used for aligning CB equipment. For example, with suitable crystals, it will indicate the band ends much more accurately than will the conventional signal generator. It can, therefore, be used for setting receiver tracking.

If you normally operate on only one channel most of the time, select a crystal suitable for that channel and place it in the calibrator. Turn the unit on and set it down near your antenna. Adjust the antenna's length and matching network (if there is one) for maximum pickup. When this is done, you can be sure your antenna will deliver maximum performance, both receiving and transmitting, on the band you use most often.

And don't forget the original reason for building the calibrator—it will point out your transmitting frequency quite accurately on your receiver's dial. After operating the unit for a while, you will probably come up with several additional applications for it. -30-

HOW IT WORKS

The calibrator uses a single drift transistor, connected in the common-emitter arrangement as an oscillator. When switch *S1* is turned on, a pulse is fed to the transistor's base through resistor *R1*. The pulse is amplified and appears at the transistor's output—tank circuit *L1-C1*.

Part of the pulse is fed back to the base through the crystal. The crystal sets the operating frequency and acts as a feedback path. Although the crystal is cut for approximately 9 mc., the circuit oscillates at its third harmonic—about 27 mc.

Base bias is determined by *R1*, with the exact value depending on the transistor used.

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In addition, you receive Printed Circuit materials, including Printed Circuit chassis, special tube sockets, hardware and instructions. You also receive a useful set of tools, a professional electric soldering iron, and a self-powered Dynamic Radio and Electronics Tester. The "Edu-Kit" also includes Code Instructions and the Progressive Code Oscillator, in addition to F.C.C.-type Questions and Answers for Radio Amateur License training. You will also receive lessons for servicing with the Progressive Signal Tracer and the Progressive Signal Injector, a High Fidelity Guide and a Quiz Book. You receive Membership in Radio-TV Club, Free Consultation Service, Certificate of Merit and Discount Privileges. You receive all parts, tools, instructions, etc. Everything is yours to keep.

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Robert L. Shuff, 1534 Monroe Ave., Huntington, W. Va.: "Thought I would drop you a few lines to say that I received my Edu-Kit, and was really amazed that such a bargain can be had at such a low price. I have already started repairing radios and phonographs. My friends were really surprised to see me get into the swing of it so quickly. The Troubleshooting Tester that comes with the Kit is really swell, and finds the trouble, if there is any to be found."

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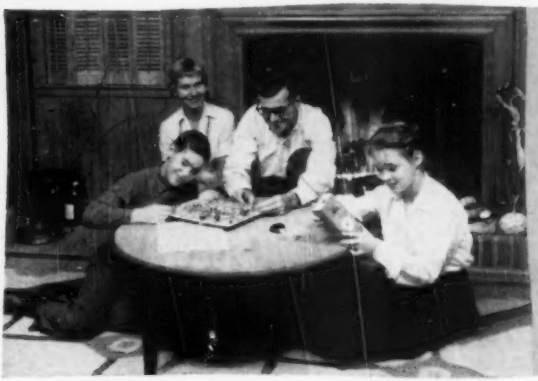

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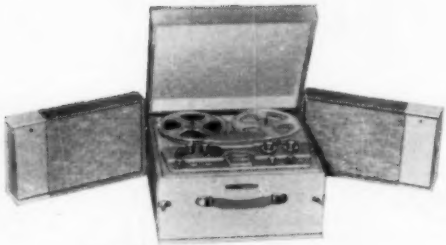

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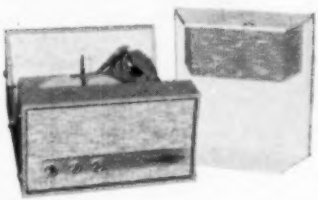

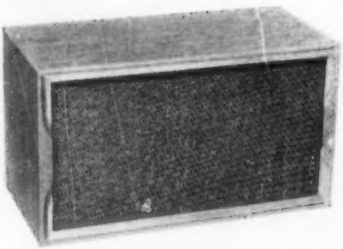

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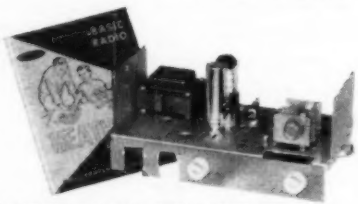
Model HWM-29-1. . .Converts early "Sixer" to "A" model. 1 lb. **$4.95**



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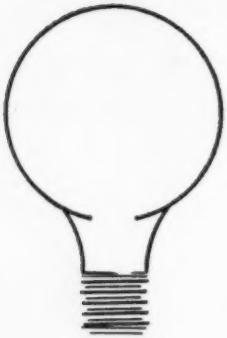
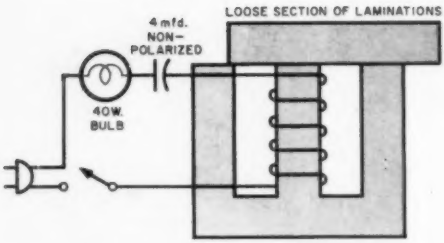
Oscillator Experiment



You can put the ferroresonant properties of a choke to work in a relaxation flasher circuit. Simply remove the frame from an old 500-ma. choke having an inductance of at least one henry. Then place a section of loose laminations over the "E" portion of the choke which is connected in the 117-volt a.c. circuit shown.

The point of adjustment is quite critical and requires a bit of patience. Start with the stack of laminations completely over the "E" section; under these conditions, the 40-watt bulb should be extinguished. Now slowly move the stack to the point where the bulb lights, taking care to open and close the switch with each adjustment to start oscillation. Near the on-off point—probably within 1/32 of an inch—a resonance setting will be found where the bulb will flash on and off at intervals of a second or so.

—Martin H. Patrick

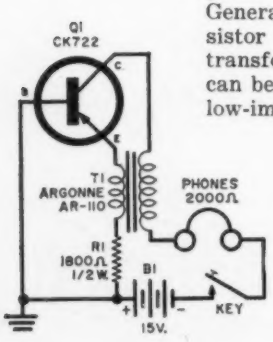


CODE PRACTICE OSCILLATOR

So small that it can be carried in your pocket, this simple code practice oscillator is ideal for building up your code speed to the General Class level. The schematic shows a CK-722 *p-n-p* transistor (*Q1*) hooked up to an Argonne AR-110 transistor output transformer (*T1*), but virtually any transistor or transformer can be used. The transformer impedances aren't critical, but the low-impedance winding must be in the emitter circuit.

If you use an *n-p-n* transistor, reverse connections to battery *B1* so that the positive terminal is connected to the key. Simply reverse *either* the primary or secondary connections if the unit refuses to oscillate. A 15-volt battery is shown in the schematic, but the oscillator will work with voltages as low as 1.5 volts. Crystal phones can be used if they are shunted with a resistor of about 5000 ohms.

—Wm. Shmigelski



By
JOHN T. FRYE
W9EGV

Carl and Jerry

A Rough Night

THIS is one time I wish we'd listened to our folks," Carl confessed as he strained his eyes to penetrate the darkness and the ice which was freezing on the windshield despite the efforts of the busy wipers.

"Yeah," agreed his pal, Jerry, who was sitting on the right side of the car but "driving" just as hard as Carl.

The boys had coaxed until their parents reluctantly agreed to let them drive to a town fifty miles from home to see the local team play basketball. The highway had been perfectly clear, and the temperature was in the high 30's when they went into the gym. But when they came out, several hours later, a light rain was falling and the temperature was dropping.

They had started for home immediately; but before they had gone five miles, they knew they were in trouble. The temperature slid down a little more, and the rain started to freeze and become mixed with flurries of sleet. As they crept along the ice-coated highway at a bare twenty miles an hour, they were even too scared to operate their mobile ham radio.

They had reason to be frightened. They passed car after car that had slid off into the shallow ditches along the side of the road and been abandoned. For the past half hour they had not seen another car or even a truck coming in the opposite direction, nor had they seen any headlights on the highway behind them.

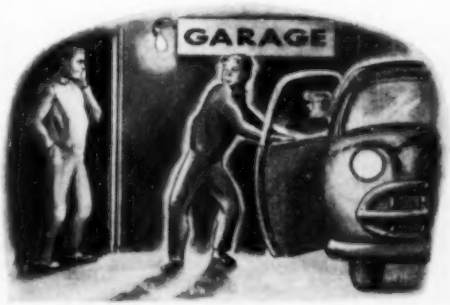
"We'll never make it through those hills a couple of miles ahead," Carl said as he unclinched his right hand from the wheel and wiped his sweating palm on his jacket. "What would our folks want us to do?"

"They'd want us to keep from getting hurt or stacking up the car," Jerry answered promptly; "and I'm with them." He used his handkerchief to wipe the steam from the windshield. "That means we'd better tie up at the first place we can get in out of the weather. If we could just let the folks know—hey, take it easy! See that light ahead?"

Carl lifted his foot from the accelerator and let the car coast. As they came closer, the boys saw that the light came from a bare bulb on the end of a pipe gooseneck over a "Garage" sign on the front of a small concrete block building. Carl touched the brakes, and the car slowly spun around in a half circle and came to rest in the garage drive.

"Whew! That was close!" Jerry gasped as he opened his door and stepped out. His feet promptly slid out from under him, and he had to grab the door to keep from falling.

"How did you two ever get here?" a voice called from the garage. Carl and Jerry saw a short, powerfully-built,



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pleasant-looking man with a butch haircut standing in the open doorway.

"You're the first car I've seen on that highway in an hour," he said. "Come on in out of the wet."

THE INSIDE of the small building was cosily warm, thanks to a potbellied coal stove glowing over in one corner. The man introduced himself as Chuck Ray and said that his house was right behind the garage; he had come out to fire the stove so the garage would not be so cold when he went to work the next morning. The boys explained their predicament and asked if they might use his telephone to call home and if they could stay in the garage for the night.

"I think we can do better than that," Chuck said with a friendly grin. "I sort of cotton to a couple of young fellows who've got sense enough to get off the highway when it's not safe to drive. If that phone is still working, you call your folks and tell them the wife and I will put you up tonight."

The telephone was working, and Jerry's call to his home went right through. Mr. Bishop answered, and Jerry quickly explained the situation. Mr. Bishop said he was glad the boys had used their heads and that he would call Carl's folks at once. Before Jerry could reply, there was a click in the receiver and the telephone went dead.

"It's no use," Chuck said as Jerry jiggled the button in the telephone cradle. "I'm surprised the ice hasn't taken the telephone wires down before this, and the power lines, too, for that matter—"

Right in the middle of his sentence, the lights in the garage went out.

"Me and my big mouth!" Chuck muttered as he stumbled around in the darkness hunting for his flashlight. He finally found it and, with its aid, he found an old coal-oil lantern as well.

The three of them were standing there in the feeble yellow light shining through the lantern's smoky globe when there was a loud knock at the side door of the garage. Chuck opened the door to let in two men, one well-dressed and the other in working clothes.

"I'm Dr. Carney, director of the research laboratory across the highway," the better-dressed man introduced himself. "This is Sam Vernon, our main-

tenance man. We're in trouble, and we hope you can help."

Sam placed an object wrapped in a greasy cloth on the bench beside the smoking lantern. He spread back the edges of the cloth to reveal the broken parts of a gasoline-engine distributor.

"That's the distributor from the engine of the auxiliary power plant at the lab," Dr. Carney explained. "This afternoon, of all afternoons, one of our men was moving some pipe on an electric truck in the basement. He misjudged distance and rammed the end of a two-inch pipe right through the distributor. It's imperative we get power back at the lab within the next two hours. Can you fix that distributor?"

Chuck poked around in the broken pieces of metal and Bakelite with a forefinger, then shook his head.

"The only thing that will fix that distributor is a new one," Chuck said bluntly; "and I'm certain you won't find one closer than Center City. The electric company can't do much with the power lines until this is over, and your auxiliary plant won't run without a distributor. Only a woolly worm with a sandpaper belly could travel on this ice, and *he* couldn't make a round trip to Center City in two hours. I'm afraid you'll just have to wait until the lines are repaired or the ice melts off the highway."

Dr. Carney paced nervously up and down the dimly-lit garage as he spoke again. "Let me try to explain how important it is for us to have power at the lab. Over there in a tiny sealed cubicle, an experiment that involves literally years of tedious, painstaking work is coming to a climax. Certain cultures are

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growing in that little room under carefully controlled conditions of temperature, humidity, ionization, and radiation. If power can be restored to the various pieces of equipment maintaining the proper conditions within two hours, the experiment can be carried to its conclusion. If power is not restored, the whole experiment, with its hundreds of steps, will have to be started over."

He paused for an instant and then said very slowly and quietly, "I can't be too specific, but let me say this: if that experiment can be carried to a conclusion *now*, and if it turns out as we hope, the restoration of power could mean that victory over one of humanity's greatest scourges would come three years sooner."

A LONG, thoughtful silence settled over the garage. Finally, Jerry cleared his throat and said in a hoarse voice, "We have a mobile radio station in our car outside. Maybe we could get word to Center City and they could manage to send the distributor to us somehow."

Chuck was sliding back the big door of the garage before Jerry finished speaking. "We'll push the car in," he said. "It's worth a try and a lot better than doing nothing."

Once the car was inside the garage, the boys saw with relief that the wooden rafters of the ceiling were well above the tip of the whip antenna fastened to the car's rear bumper.

Jerry turned on the receiver and quickly flipped from one band to another. "Seventy-five and forty meters are out because of static," he observed. "We can't buck the kilowatt QRM on twenty with our flea-power. Fifteen and ten sound dead, but at least there's no QRM or QRN on them. Maybe some of

the boys will be listening on ten for ground-wave contacts."

He switched on the transmitter. After it had warmed up for a minute, he pushed the button on the side of the carbon mike. The motor generator in the trunk compartment whined, but Jerry soon released the push-to-talk button without speaking into the mike. "Something's wrong," he announced as he frowned at the little meter sitting on top of the dash. "I see practically nothing on the field strength meter."

"I bet it's the ice detuning the antenna!" Carl exclaimed, pointing at the quarter-inch-thick sheath coating the slender whip.

Chuck, man of action, had already picked up a propane torch from the bench and lighted it. He carefully played the blue flame up and down the antenna until the ice melted and fell off. Now when Jerry peaked up the transmitter on the ten-meter band, the field strength meter indicated satisfactorily.

"CQ, CQ, CQ Center City with emergency traffic," he said into the mike, and signed his call. He repeated this three times, then cut the transmitter and listened across the band. Not a signal was heard. He tried a longer call, with the same result.

But Jerry didn't give up. After the seventh transmission, the straining ears in the garage heard a very faint and faraway voice repeating Jerry's call. As the operator of the other station signed over, he said he was in Center City!

Jerry went back to him and asked if he had a telephone. There was a long silence, and then the station operator came on and said he could not copy Jerry. Could Jerry do something to increase the strength of his signal just a little bit?

Hurriedly Jerry checked the transmitter tuning, but it was right on the nose and putting out everything it had.

"Let's turn the car so it points toward Center City," Carl suggested. He started tugging at the wheel and pushing on the doorpost. They all helped.

THE OTHER STATION was still calling, and was coming in stronger. When Jerry went back to him, the Center City operator reported that he was

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able to read Jerry's signals quite well.

"When the antenna is mounted on the rear bumper, the car acts as a director and puts a lobe of signal out in front," Carl explained in a whisper to Sam.

Dr. Carney took over the mike and told the operator in Center City to call a certain number and explain the situation. Identifying numbers from the power plant and the distributor were passed along.

It seemed as if hours passed before they heard him again, but it was actually less than a half hour by Carl's wristwatch.

"I've got the information," the faint voice said; "do you copy?"

Jerry pushed the button. The relay clicked, but the generator didn't start. "The battery's gone dead!" Jerry groaned as he noted the dimming of the car's dome light.

But Chuck was already busy. He jerked up the hood and snapped the clips of a pair of heavy car-starting cables to the battery terminals. Clips on the other ends of the cables were fastened to the terminals of a battery he took from a charging rack. "Now try her," he said.

The transmitter took right off, and Jerry told the frantically-calling Center City station to go ahead.

"Your man has located a new distributor," the operator reported. "He's on his way now to pick it up and take it to the airport. The rain isn't freezing here, and conditions are not so bad; so a small plane is going to try to drop the distributor to you on a parachute. Can you arrange some sort of signal he can see to locate you?"

"Can do!" Chuck exclaimed, and he grabbed a handful of red truck fusees from a box beneath the bench.

Arrangements were completed and relayed to the pilot at the airport who said he would take off immediately. Jerry stayed with the mobile station while the other four went outside to arrange the fusees in a big square along the deserted highway.

It was not long before they heard the throbbing of the plane motor. After a couple of passes over the bright red glow cast by the lit fusees, the plane lights came straight toward them down the

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highway flying very low. Shortly after the plane roared over, Carl saw a small parachute floating down toward him. He grabbed the carton dangling beneath it the way he would snare a football pass,

while Chuck grabbed up a fusee and waved a signal of success to the plane that roared off into the night.

They all went across the highway to the laboratory, where Sam and Chuck installed the new distributor in jig time and started the generator. Lights came on all over the building, and they trooped upstairs to watch Dr. Carney make an anxious, hurried check of several meters mounted in a big console.

"We made it!" he announced, and then slumped wearily into a chair. "It was close, but conditions inside the cubicle are still within the limits set for the experiment."

WE can hash all this over in the morning," Chuck said with a satisfied yawn, as he headed for the door. "Right now, boys, let's go home and get some sleep. It's been a long, rough night."

Soon Carl and Jerry were snuggled down in a warm, comfortable bed. Just before they went to sleep, Jerry observed:

"Carl, a half dozen times tonight I wouldn't have given a burned-out resistor for our chances. One thing after another kept going wrong. But all of us, working together, jumped on each new obstacle as it reared its ugly head; and everything turned out fine. Don't let me forget this, will you?"

"Uh-uh," Carl agreed drowsily. —30—

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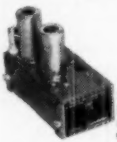

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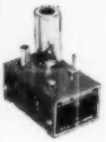

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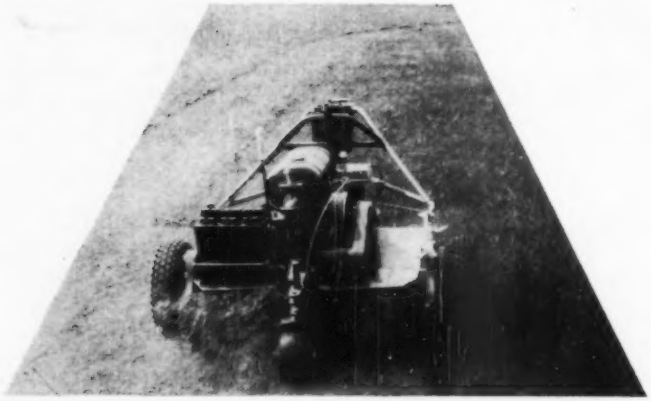

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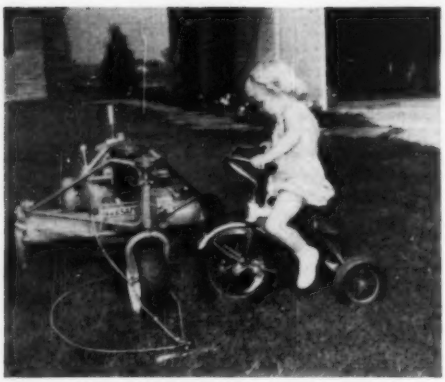
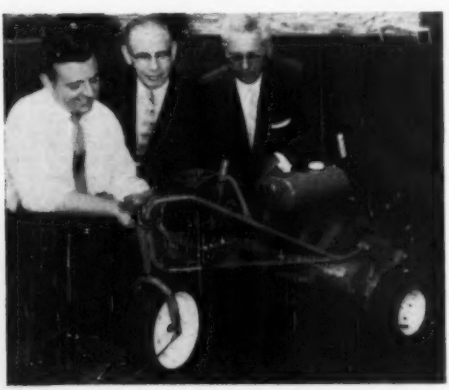


Child-proof to the nth degree, the lawn mower stops when little tots or their pets cross its path. Gordon Carlson, T. J. Lafeber, and W. C. DeVry (below) of DeVry Tech, inspect with pride this product of their research laboratories.



THE DREAM of many home owners is to build a mechanical man to mow the lawn. Mr. T. J. Lafeber, President of the DeVry Technical Institute, stopped dreaming and came up with a practical design for a robot lawn mower.

The robot's brain is an electronic sensing device which is attached to a standard power-driven lawn mower. The mower is guided over the lawn by a pattern of electric wires imbedded in a shallow slot cut in the sod—which quickly heals over, leaving no visible trace on the lawn surface. Small electric current pulses pass through the buried wire and set up a magnetic field which is used to guide the mower along a predetermined path.

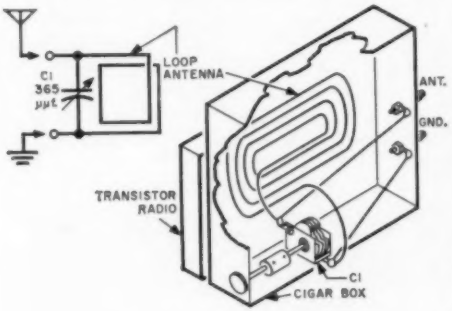
A probe on the front of the mower picks up magnetic impulses around the buried wire and sends them to a small plastic box containing a transistor amplifier. The amplified impulses are interpreted by a directional unit which tells the mower to follow the imbedded wire by means of a simple servo steering system. A safety device instantly shuts off the mower should children, pets, or other objects get in its way.

To send the robot on its tour of duty, the operator starts up the gas engine, flips a few switches to "on," and watches the mower take off on its appointed rounds. There is no reason to wait around because the mower will head back to its storage space when the mowing is done, and put itself away. -30-

Tips and Techniques

RADIATION LOOP ANTENNA

Most transistor portables have no outside antenna jack and are therefore insensitive to weak signals. But, with a radiation loop, an outside long-wire antenna can be used without any connections to the radio. The loop is essentially a tuned circuit which will re-radiate the signal picked up by an outside antenna to the transistor portable. Build the loop in any wooden or cardboard (not metal) box, mounting a replacement-type loop antenna inside the box and connecting a 365-$\mu\mu$f. variable capacitor across the



loop's terminals as shown. Each capacitor terminal should also be connected to a separate binding post; one binding post serves as a terminal for the outside antenna, the other for the ground. To use the loop, place a transistor portable against it and connect the long-wire antenna and a good ground to its binding posts. Then, with a weak station tuned in on the transistor portable, adjust the tuning capacitor in the radiation loop for best reception. In some cases, reversing the position of the portable may boost pickup from the loop.

—*Jerry Carmean*

CAR RADIO SWITCH REPAIR

On many car radios, a d.p.s.t. switch is used to turn the radio on and off and to operate the dial light. Such switches will often burn out on the radio half although

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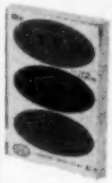

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Tips

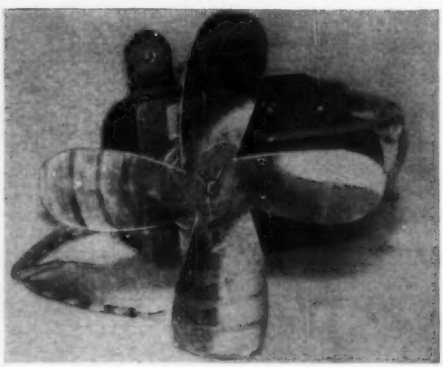
(*Continued from page* 111)

the dial light half will remain operative. To get the set working again temporarily, remove the dial light leads from the switch and solder the radio's on-off leads in their place. The entire switch should eventually be replaced with a new one, however.

—*David Held*

PHONO MOTOR COOLING FAN

If you have an old 78-rpm turntable that is no longer being used, you can make a cooling fan from its motor plus a small fan blade. Since most such motors are of the "shaded-pole" type which cause no radio interference, the fan you make will be fine for cooling communications

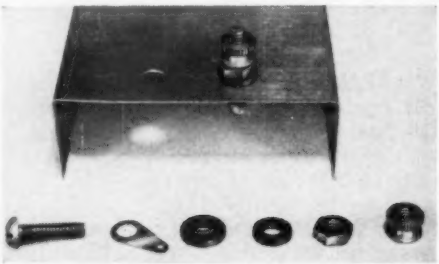


receivers, TV sets, or small transmitters. The turntable motor can usually be dismantled with its shock mounts intact. Make the fan blade from sheet metal or buy a ready-made 4- to 6-inch blade. The completed fan can be mounted at the rear of the equipment to be cooled and should be wired to the set's on-off switch.

—*Terrence Koch*

INEXPENSIVE BINDING POSTS

Insulated plastic binding posts are good-looking, and they lend a professional appearance to home-built electronic equipment—but they're expensive. You can make a low-cost substitute by combining several hardware items found in almost every junk box. Use a ¾"- to 1"-long machine screw, a solder lug, flat and shoulder fiber washers, a hex nut, and a knurled thumb nut for each binding "post" you need. Assemble these parts in order, using the fiber washers to insulate the assembly from a metal chassis. For improved appearance or for color



coding, you can paint the outer surface of the knurled thumb nut with model airplane dope or with fingernail polish.

—*Luis Vicens*

NEON PILOT LAMP

Many electronic kits are supplied without any pilot lights and are inadvertently left on when not in use. You can avoid unnecessary power drain with a neon lamp on-off indicator. All you need do is wire a Dialco 931H neon pilot light assembly to the equipment's on-off switch

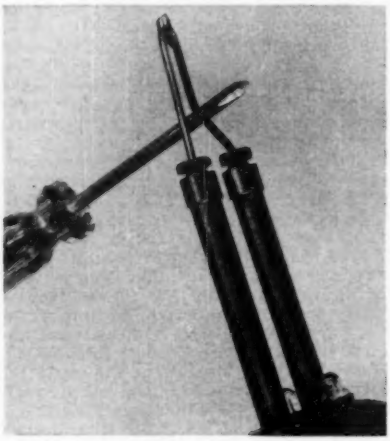
and install an NE-51H neon lamp. The assembly has a built-in 18,000-ohm resistor which is just right for the high-brightness lamp.

—*Clyde C. Cook*

DEMAGNETIZING TOOLS

You can demagnetize screwdrivers or other tools with a standard soldering gun. Depress the gun's trigger and, holding

the trigger down, move the tool through the open loop of the gun's tip, as shown in the photo. Then move the tool slowly out of the loop and away from the gun before releasing the trigger switch—if the trigger is released suddenly while the



tool is close to the tip, the tool may be more strongly magnetized than it was originally. If the tool is too large to pass through the open loop, simply hold it close to the tip, or near the transformer at the rear of the gun.

—E. G. Louis

PUSH-DRILL FOR CIRCUIT BOARDS

When working with etched-circuit boards, you'll find that a push-drill of the type used by carpenters is excellent for making component mounting holes, eyelet holes and so on. These inexpensive tools generally are supplied with a complete set of drill bits and are much easier to use than an "egg-beater" type of drill. In fact, they are often easier to set up than standard electric drills. However, it's best to use a center-punch before drilling.

—Eugene Richardson

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Across the Ham Bands

(Continued from page 89)

News and Views

Bill Rogers, K3JSV, 38 Vernon St., Uniontown, Pa., got an early start as a ham. After 13 months on the ham bands, six of them as a Novice, he just celebrated his 13th birthday. Bill's record is 474 contacts in 33 states, including a couple of Hawaiian contacts. He transmits via a Heathkit DX-35/VF-1 combination and receives with a Heathkit AR-3 backed up by a QF-1 Q-Multiplier. Bill operates on 40 meters only, c.w. 99% of the time. . . . . **Fred Tich, KN5EIE,** 1092 Christy St., El Paso, Texas, has an interesting call to send on a "bug." Try it. In 2½ months, over 300 hams have mastered his call to give Fred a record of 31 states worked. Of course, there is always one who will not QSL; so his confirmed record is 30 states. Fred excites his 40-meter dipole with a Heathkit DX-20 transmitter, and the antenna excites a Hallicrafters SX-99 when he receives. Check with Fred for a Texas contact on 15 or 40 meters.

Edward K. Wolfe III, KNØYQU, 2755 N. Fernwood, St. Paul 13, Minn., feeds his Johnson Adventurer transmitter into a 7-mc. dipole, and he receives on a 25-year-old RCA ACR-175. His dipole antenna is about 20 feet high. Ed has worked 18 states and has confirmations from half of them—you can guess what he thinks of hams who promise to QSL and never do. Ed was thrilled to receive a phone call from Willie, KØKRT, after their first contact. Willie explained that he phoned all new Novices that he worked in the Minneapolis-St. Paul area to make them welcome to the hobby—a fine example of the true ham spirit. . . . . **Rod Morris, WV2MDZ,** 135 Shepherd Lane, Roslyn Hts., L. I., N. Y., really has been keeping the ionosphere around his antenna stirred up. In two months as a Novice, he has worked 17 countries and 48 states, all confirmed! His transmitter is a Globe Chief 90A running 75 watts and feeding a High-Gain 14AV vertical antenna. He receives with a SX-99 helped along by a QF-1 Q-Multiplier. Rod is another of those hams who have replaced the 6SG7 r.f. tube in their receivers with a 6AC7 as discussed in the March 1960 column—with excellent results. He hopes to pass his General exam soon and offers to help prospective Novices obtain their tickets. . . . . **Neil W. Zimmerman, KNØYDO,** Box 143, Finley, N. D., works 40 and 15 meters with his DX-35 transmitter and SX-99 receiver plus Q-Multiplier. Neil is waiting for his new National NC-270 receiver to arrive. He could use some suggestions from other users of the Gotham V-40 vertical antenna on how to "load" it with his DX-35. Neil is a radar repairman at the Finley, N. D., Air Force Base—he shouldn't have too much trouble getting his General Class ticket.

Lt. Roy C. Hejhall, USN, USS Des Moines (CA-134), F.P.O., New York, N. Y., is WØTRH when he's in St. Paul, Minn. But while serving on the flagship of the U. S.

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Sixth Fleet in the Mediterranean, Roy makes his home in Villefranche Sur-Mer on the French Riviera. The French government just issued him a license and the call letters F7BM. When you read this, he will be on 20 meters looking for W's. Roy calls his rig a "French kilowatt." Actually, it's a Knight T-50, but its 50-watt input represents the maximum French ham power limit on 80, 40, and 20 meters. On 10 and 15 meters, the limit is 100 watts. . . . . **Bob Jones, W6EDG,** who listens but cannot transmit, has sent us another list of calls heard in the Philippines in the 15-meter Novice band: W1DMD, K1IVQ, K1LMO, KN1NLW, KN1PIF, KN1PSK; K2DQR, WV2DTK, W2LWH, WA2LYT; KN3LPI, KN3LSS; KN4ZHI; KN5CGU, KN5CWS, KN5EOT, KN5YVQ; WA6CAA, WA6COS, WA6DCG, WA6FCZ, WA6FMF, WA6IJH, WA6IRK, WV6JPS, WV6JRK, WV6KEA, KN6KHT, WV6KNT, WV6KXY, WV6KOJ/MM, WV6KRS, WV6KZI, WV6LHX, WV6LIO, WA6LPF, WV6MBI, WV6MBT, WV6MCI, WV6MDO, WV6MIR, WV6MJG, WV6MFY, WV6MRO, WV6MVZ, WV6MZY, WV6NDD, WV6NPA, WV6NTO, WV6NTQ, K6PKI, K6QPH; KN7JUU, K7KTQ, KN7KZA/5, KN7LHR; KN8TJZ, KN8TRJ, KN8UHB, KN8VAF; KN9AJY, KN9VKF, KN9VLZ, KN9WEP, KN9YKN, KN9YVV, KN9ZCR, KN9ZEJ, KN9ZKA, KN9ZPJ; KNØAUF, KØVVV, KNØZSR; WH6DPB, WH6DNA, WL7DJI, and WL7DQF.

Ron Beitman, KN8VIX, 3729 Oakwood Dr., Amelia 3, Ohio, beat his dad, Irv, KN8WDU, by a few months in getting his license. So Ron has a more impressive record—30 states worked and 22 confirmed. Their station consists of a Globe Chief 90A transmitter, a National NC-183 receiver, and a 180′ longwire antenna. A new vertical antenna is on the way.

Why not start out the new year by sending us a letter about your activities? Include a picture if you have one available. 73,

Herb, W9EGQ

T	H	E	R	M	I	S	T	O	R	E	F
P	L	I	C	E	L	E	C	T	R	O	L
S	L	A	M	I	N	A	T	I	O	S	E
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L	P	X	E	L	G	G	O	T	N	E	E
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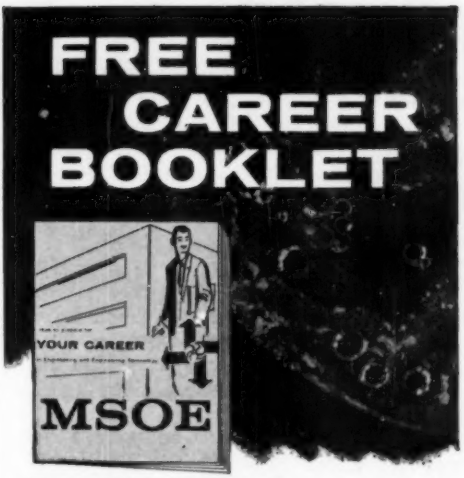
Answers to roundword puzzle appearing on page 84.



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IM Distortion Analyzer

(*Continued from page 66*)

you can measure IM distortion by setting up two signal generators, the necessary filters, and a VTVM as shown in the block diagram. One tip—most careful workers use the bridge circuit shown in Fig. 5 for connecting the output of the generators to the amplifier input. Since each oscillator is connected across the bridge at a point where the other's signal is at a null, they do not interact with each other to produce an intermodulated test signal. The combined signals—with no intermodulation—appear across *R1* and are applied to the amplifier under test.

The Complete Picture. Generally, when measuring an amplifier for IM, you'll want to get the complete picture by checking the unit over its entire power range. It's a good idea to start measuring IM at the one-watt output level, or even lower, then gradually increase the output power until you reach the amplifier's maximum power rating. At this point, the IM figure will go up sharply as the low-frequency component begins to drive the high-frequency signal into the cutoff region.

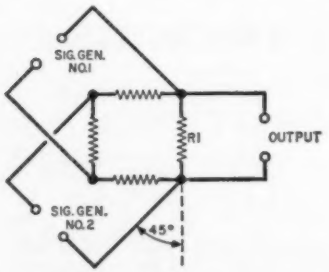

Fig. 5. Standard bridge circuit used for connecting two signal generators to a single audio amplifier. All resistors should be equal in value.

Incidentally, there is a trick you might keep in mind when making IM measurements. The meter you use to measure the power output of the amplifier will, of course, read the r.m.s. value of the output signal. In the case of an output sine wave, this is just what we want, because all of our standards are based on r.m.s. readings. But when we add the high-frequency component, this upsets the applecart. The meter will still read something very close to the r.m.s. value of the low-frequency signal. Yet the peak power, due to the excursions on either side of the low-frequency sine-wave signal made by the h.f. component, will be much larger.

All of this means that you may run into severe clipping of the h.f. component while the output meter is still reading within the amplifier's rated power. For this reason, engineers have set up an "equivalent single frequency r.m.s. value" for the mixed output signal. This standard specifies that the mixed signal power is to be calculated as 1.47 times the r.m.s. meter reading.

Let's take an example. To find the sine-wave power output at any given voltage reading across the load resistor, simply use the formula: $P=E^2/R$. But if the signal being amplified is a mixed signal such as we have been discussing, i.e., a signal with a 4:1 voltage ratio, then we use: $P=1.47(E^2)/R$, to get the "equivalent single-frequency r.m.s. value." Thus, if you were feeding a sine wave into an amplifier, and the output meter read 10 volts across an 8-ohm load, the power would be 12.5 watts. But if you read 10 volts of mixed signal across the same load, the equivalent power output would be 18.4 watts.

To find out what voltage will have to appear across the load to give a certain output power—for example, if you want to operate an amplifier to produce 15 watts of power with the mixed signal—a little elementary algebra will turn the formula given in the above paragraph into: $E=\sqrt{PR\div 1.47}$.

Testing Other Components. To measure the IM distortion of a microphone, it's best to use two separate power amplifiers driving two separate speakers, one at the high frequency, the other at the low frequency. With only one amplifier and speaker amplifying both signals, some IM might be introduced in the test signal. Connect the microphone output to the best preamplifier you can find and channel the preamp output into the distortion meter for the reading.

Incidentally, if you have two audio oscillators, you might consider using frequencies somewhere near 200 and 3000

cycles instead of the 60 and 7000 figures we have been using as examples above, since with most speaker systems you can get somewhat purer signals in this range. It's also a good idea to move the experimental setup of speakers and microphones around in the test room and see if the results change. Unless you have a room that is almost acoustically "dead," sound reflections and standing waves can seriously alter your results. One final point: when you're setting up the 4:1 ratio of high or low signals, measure the levels at the microphone preamplifier output.

You can check the IM of your phonograph pickup cartridge by using one of the standard IM test records available. Simply connect the amplifier output to the IM meter and make the reading. Be sure that the test frequencies lie within the frequency range of the instrument. (The Heath AA-1 can accommodate low signals from 10 to 500 cycles, high signals from 2000 to 12,000 cycles.)

If you have a microphone and audio amplifier of known low distortion, you can check the IM of a speaker. Simply feed the two signals through the amplifier to the speaker under test, pick up the sound with the microphone, and measure IM with the meter.

Because of the built-in high-pass filter in the AA-1, it will operate as a very sensitive high-frequency noise meter. One possible application would be bias voltage adjustments on a tape recorder. As you know, the high-frequency noise level rises sharply if the bias is not at the proper level. Set the IM meter test switch to *"Operate,"* and the range switch to *"Set Level."* The tape-recorder output is now channeled through an amplifier and high-pass filter (see Fig. 3) and into the VTVM. The last step is to adjust the tape bias carefully for lowest noise. This adjustment can be made very accurately, since the filter will eliminate all flutter, wow, and other low-frequency signals.

There are many other uses for this versatile "combination of instruments"—measuring flutter, transient ringing, turntable rumble, amplifier hum and noise; the possibilities are almost endless. And, like all test instruments, the better you understand the IM analyzer, the more useful it becomes. -30-

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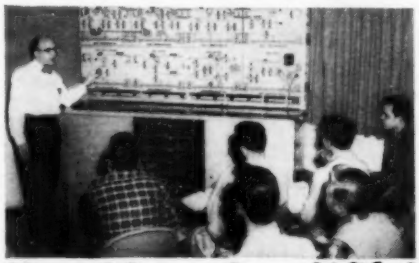

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Transistor Topics

(*Continued from page 82*)

watts in Class B, and are capable of switching 1000 watts.

International Rectifier Corp. (El Segundo, Calif.) has announced a new series of high-voltage silicon plug-in rectifiers equipped with tube bases to allow direct replacement of electronic tube types 6X4, 12X4, 0Z4, and 6X5. Rated at 1250 volts peak inverse voltage at 80-ma. d.c. output, the ST-8 rectifier is designed to replace the 0Z4 and 6X5, while providing better surge current capabilities, less noise characteristics and high-temperature operation on vibrator-type power supply applications such as auto radios, military and commercial portable radios, and other communication systems. The ST-8 measures 1.10″ x 1.40″ in diameter. Rated at 1500 PIV at 75-ma. d.c. output, the miniature 1N570 is designed to replace MIL types 6X4 and 12X4 vacuum tubes in a wide range of power supply applications, including radio, television, and test equipment, computers and related data processing equipment. The extremely compact and rugged 1N570 measures only 0.845″ x 0.710″ in diameter and has the same temperature characteristics as the ST-8. For detailed information on the two types, request Bulletin SR-209B.

Don't neglect to obtain a copy of Lafayette's latest catalog #610 (available from Lafayette Radio Electronics Corp., 165-08 Liberty Ave., Jamaica 33, N.Y.). This 322-page "bible" is loaded with semiconductor bargains in both parts and equipment. Of particular interest are the many transistor radios, including the AM-FM types mentioned earlier. Also available is the new Lafayette "Semiconductor and Industrial Catalog," which lists characteristics, design specifications, applications, and circuits for the semiconductor devices represented. Designed for industrial users, this catalog also covers many other devices of importance to industry, and is an invaluable reference guide. When writing for your free copy, ask for BK-1300.

So much for the semiconductor situation. Here's hoping 1961 will be a happy and prosperous year for you.

—Lou

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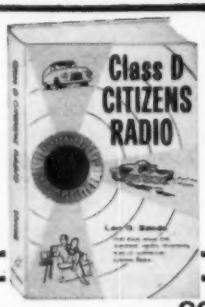

CLASS D CITIZENS RADIO — Leo G. Sands

Here is the first complete book on Citizens Radio Operation. Ever since the initial use of 2-way radiotelephone by police departments, this field has been growing in importance and application. Now, with more than a million vehicles equipped for its use, Citizens Radio is a major phase of the electronics field. This important new volume covers every aspect of the field—its history, rules, and everything about how it works—in seven big chapters with one hundred major sections. You'll learn exactly what Citizens Radio is, its applications, what equipment you need, the full story on receiver circuits and transmitters, antennas, installation, and maintenance, full FCC rulings, how to apply for licenses, etc. Many illustrations. **$4.95**

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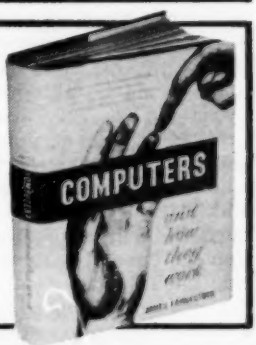

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Lightning

(*Continued from page* 62)

that it will have no difficulty dissipating a heavy lightning charge; generally, the more down-running conductor cables, the better, since a multiple group of parallel paths greatly reduces electrical resistance. All conductor cables must be free of sharp bends that can encourage dangerous arcing; bends can have no less than an 8" radius and any turn must not exceed 90°.

Down conductors end in ground rods sunk deep into moist earth. These ground rods must be either solid copper or copper clad, at least a half inch in diameter, and 10 feet long. A minimum of two ground rods are necessary, and they should be at opposite ends of the house.

In addition, every metallic object in and on the house—radio-TV antenna masts, metal sidings, or eaves, plumbing and heating pipes, ventilating systems—must be bonded together in the protection system and grounded. This prevents side flashes, and it also guards against charges being induced in these objects by a lightning strike, or even a direct entry by lightning.

Price Factors. Except for the ground rod, aluminum can be used in lightning protection systems in place of copper. Aluminum is cheaper, but because it is less conductive, parts made of this metal must necessarily be heavier and larger than similar copper parts—making it harder to conceal the elements of an aluminum system. In any event, clamps, connectors, and fasteners must be of the same material as the conductor cables.

If you like, you can buy a kit and make your own installation. A copper kit for a roof ridge running 60 to 80 feet costs between $100 and $200. An aluminum kit, generally used only for metal roofs, is available for less than $100.

You'll want to consider the insurance angle. A lightning protection system with a Master Label from Underwriters' Laboratories can earn you a lower fire insurance rate. The only way to get such a Master Label is to have the system installed by a UL-approved contractor. In the long run, this may prove the more economical approach, particularly when you realize tnat the standard guarantee runs 50 years and covers free replacement of defective parts.

Antenna Protection. Although you may not feel a full investment in a complete lightning protection system is justified in your particular case, you might find it worthwhile to protect your antennas. As a matter of fact, if your antenna mast is spotted in the center of your roof and there are less than 20 feet of roofing running out on either side, an antenna can be rigged so that the entire house is adequately protected.

The rules are pretty much the same as with a regular protection system. A good copper cable should be connected to the mast with an appropriate cable clamp. The cable is then run along the roof ridge in either direction. If you have more than one antenna mast, of course, they should be tied into the roof-spanning conductor. The down-conductor and ground-rod setup is just the same as with a full-scale, standard protection system.

Antennas call for additional protection —a lightning arrester which serves to prevent lightning from entering the house via the antenna lead-in. Special lightning arresters are also designed to protect power and telephone lead-in lines.

Actually, the term "arrester" is a misnomer, since the real function of this device is to shunt lightning, or lightning-induced current, to ground. It makes physical contact with the wires in your lead-in cable and is in turn connected directly to a ground rod. An arrester can be attached to an antenna mast proper, but for real protection one should be installed at the point where the lead-in begins. It should be at least as close to ground as is the equipment connected to the lead-in wire.

If your lead-in wire is a shielded cable, merely grounding the shield will serve the same purpose as a lightning arrester. In fact, some authorities recommend running shielded lead-in cable right into the ground before running it into the house.

Just what kind of protection system will best suit your needs is ultimately your decision to make. But of this much you can be certain. With a system that is properly installed and carefully engineered, the charge you get out of the next thunderstorm will go safely to ground. And ground is precisely where it wanted to go in the first place. —30—

Thinking Man's Radio

(*Continued from page* 70)

alignment tool, adjust the i.f. transformers (starting with the first one and working "forwards") for maximum output from the speaker. Always keep the generator's output as low as possible. Repeat the i.f. adjustments two or three times to compensate for interaction.

Next, set the generator to about 1620 kc. and open the set's tuning capacitor fully. Adjust the trimmer marked *"Osc."* (on the back of the tuning capacitor) for maximum output. Then move the generator's output to 530 kc., close the tuning capacitor, and adjust the slug on the oscillator coil for, as before, maximum speaker output.

Shift the signal to 1400 kc. and tune the receiver until you pick it up. Adjust the antenna trimmer (also on the back of the tuning capacitor case) for maximum sound. Finally, set the generator to 1000 kc., tune the set to pick up the signal, and adjust the antenna coil slug.

Final Assembly. There will be a few small pieces of scrap plastic left over after you assemble the skull. Use these pieces to build a brace to support the speaker. Cement the brace into place only after you are sure that the speaker and chassis will fit in the skull when the top is on.

Before the speaker is put in place, two studs must be mounted on it to support the chassis. After this is done, the speaker is mounted in the skull and the chassis attached to the studs. Short metal or fiber spacers should be used to prevent the rear of the speaker from shorting against the chassis.

Place the battery wherever it seems convenient or, better yet, mount a battery holder somewhere in the skull.

Small knobs must be used on the controls if the top of the skull is to fit in place. It may be necessary to shorten the shafts somewhat. A battery binding post will serve as the volume control's knob.

In addition to its more prosaic uses, the "Thinking Man's" radio can be adapted for "Carl and Jerry" type stunts. For example, try using the radio as a spooky centerpiece at a party. It will answer questions put to it by your guests—if you station an accomplice in the next room with a wireless broadcaster. –30–

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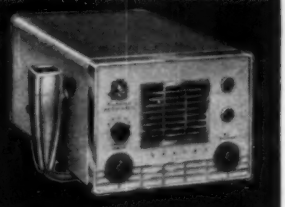

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Sweet Sixteen

(*Continued from page* 58)

such a manner that each can be easily cut to length after assembly. Tack each rail in place with small nails before drilling holes for the assembly screws. Place screws at 6″ intervals down the side, turning them in tightly, and proceed around the square in this manner until all four rails are attached firmly to the front panel.

Cut the extending ends of the side rails off flush. Be sure that the cut edge is even so that the external finish railing (*D*) will fit properly as shown in the illustrations. Save the pieces of 2″ x 6″ you cut off for use in the next step.

Internal bracing is provided by the short pieces of 2″ x 6″ (*E*). Attach them as shown in the photo, at the center and two other spots on the inside of the front panel, using at least two screws in each bracing block.

Now paint the entire front panel black with screen enamel so that the speakers won't show through the grille cloth in the completed unit. Let the paint dry—it shouldn't take more than 30 minutes—before proceeding.

In the meantime, you can attach the acoustic padding to the inside surface of the back panel (*B*), being sure to leave a 2″ clearance at each side for the side rails. Use carpet tacks or a stapler to attach the padding.

After the paint dries, it's time to apply acoustic padding to the inside surface and attach the speakers. Center each speaker over its hole and secure it with No. 6 sheet-metal screws through the mounting holes in the speaker frame. Tighten the screws lightly, and be careful not to damage the cones.

Wiring the Speakers. With all speakers attached, you're ready to wire them up. If phasing must be checked because of mixed models, connect a 1.5-volt flashlight cell to the terminals of each speaker in turn and note whether the cone moves in or out. If necessary, reverse the connections to make the cone move out. Then mark the speaker lug which is connected to the positive terminal of the cell, using a crayon or china marking pencil.

If all your speakers are identical, phasing is not necessary. Simply mark one terminal of each speaker, marking the corresponding terminals on all speakers. Consider the marked speaker terminals to have positive polarity, and wire the speakers together as shown in the diagram. Standard No. 18 hookup wire is satisfactory for connecting the speakers, but it's best to use a generous length of lamp cord for the wire (see diagram) which runs from the system to the amplifier.

At this point, only one step remains to complete the system so far as sound is concerned—attaching the back panel (*B*). Drill a small hole near one corner of the panel and thread the wire from the amplifier through the hole. Then position the back panel on the speaker box and tack it in place temporarily with small nails. Use wood screws at 6″ intervals for permanent attachment.

Dressing Up the System. All subsequent construction steps deal with the decorative finish of the system. First, the grille cloth must be attached. It's best to lay it in place, tack the center of one side, stretch the opposite side and secure it, then work from the center to each corner. When two sides are secure, repeat the process on the other two sides. A stapler works well for tacking the cloth in place, and if all tacks or staples are driven into the sides rather than into the front panel, they will be hidden when the external finish railing is attached.

The 1″ x 8″ external finish rails (*D*) should be attached in the same "ring" fashion as the side rails—secured by sixpenny finishing nails hammered flush, then cut to final length after assembly. Note that they mount flush with the rear of the box, leaving an overhanging lip around the grille cloth. Fill any cracks or knotholes with "Plastic Wood," let it dry, and sand smooth with a fine grade of sandpaper.

Now you're ready to apply the furniture finish, which consists of a square yard of "Contact" table-top material available from larger department stores (usually in the "notions" department). This material, a photographic replica of hand-rubbed wood grain in a number of patterns, is self-adhesive. Simply cut it to size, smooth it down carefully on the finish railing, and your "Sweet Sixteen" speaker system is ready to go! Want to try another for stereo? —30—

Short-Wave Report

(*Continued from page 71*)

week are devoted to nothing but letter writing.

Several readers have asked if we DX at all. The truth is that very little time is spent in actual DX'ing though we do attempt to verify as many reports as possible by actual listening. Like most DX'ers, we have a few favorite programs we listen to while answering the mail.

When you send in reports or write for leaflets or information, please bear in mind that we will reply at the earliest possible moment. And remember that while we may not acknowledge your reports immediately, they are very much appreciated, and further reports will always be welcomed.

DX Unlimited. A fairly new club, DX Unlimited, puts out a bulletin containing short-wave and amateur news, some advertising, a "for-sale" column, and, at times, construction projects. Future plans call for inclusion of a broadcast-band column and articles on hi-fi and CB activities. The club's yearly dues are $1.20, plus a 20-cent registration fee. For further information, write directly to DX Unlimited, 6216 20th St., N.W., Seattle 7, Wash. If applying for membership, list your name, address, make and model of your receiver and/or transmitter, antenna, call letters (amateur or short-wave) and any organizations to which you belong.

Current Station Reports

The following is a resume of current reports. All times are Eastern Standard and the 24-hour system is used. At time of compilation all listings are as accurate as possible. Stations often change frequency and/or schedule with little or no advance notice. Please mail your reports to: Hank Bennett, P. O. Box 254, Haddonfield, N. J., in time to reach your Short-Wave Editor by the eighth of each month.

Albania—ZAA has moved to 5955 kc., and is readable at 1735 with Eng. news but is badly QRM'ed. *(WPE3NF)*

Andorra—*R. Andorra,* 5991 kc., is heard well on certain days around 1715 with a variety of music and frequent ID's. *(WPE3NF)*

Australia—Melbourne has moved from 11,760 kc. to 11,710 kc. for the N.A. daily xmsn at 0714-0815. Another new channel is 7190 kc. where VLG7 operates at 0243-0330 in Eng. to the mid-Pacific areas. *(WPE6AIU, WPE6BOA, WPE8BAG, WPE9ADP, WPEØAE, WS)*

Austria—The Austrian Radio Shortwave

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Service, Vienna, is scheduled on 9770 kc. at 0600-0800; on 7245 kc. at 2300-0000 and 0800-1400; on 7200 kc. at 0400-0600; and on 6155 kc. at 0000-0400 and 1400-1600. Reports are welcomed and should be sent to *R. Austria,* P. O. Box 700, Vienna, Austria. *(WPE1AAC, WPE1BBB, WPE1BY, WPE3BQX, WPE9KM, MT)*

Colombia—*R. Sutatenza* has opened a new xmtr on 6075 kc. and is noted in closing at 2200 with full ID. It is dual to 5075 kc. *(WPE4BC, WPE9KM)*

A previously unidentified station is *R. Vision,* Medellin, 6105 kc., noted with news at 1845-1900. *(WPE2AXS)*

Cook Islands—ZK1ZA, Rarotonga, has moved from 4965 kc. to 5050 kc. with s/on at 2330; s/off may be at 0100 although fading usually blots the signal out by 0030. This xmsn is mostly English with Island music. *(WPE6EZ)*

England—The BBC Services timetable to Africa and the Colonies has been altered and now reads (for the time period 0445-0600 only): to Rhodesia and Nyasaland at 0445-0500 (Thursday); to East and Central Africa at 0445-0500 (Friday and Saturday); to the same areas at 0530-0545 (daily); to S. Africa at 0545-0600 (Sunday and Thursday); to Mauritius at 0545-0600 (second Tuesday of the month) and to East and Central Africa at 0545-0600 on Monday, Wednesday, Friday, and Saturday. These xmsns are all Eng. and are on 25,720 and 21,640 kc. Other schedule changes list the Pacific Service at 0300-0345 on 15,375 and 11,750 kc., and the Arabic Service on 18,080 kc. at 1100-1200, 1330-1345, and 1445-1500. A new program, "Shortwave Listener's Corner," is aired on Wednesdays at 0715 on 25,720, 21,470, 21,710, 17,870, 15,070, and 15,110 kc., and on Thursdays at 2015 on 6110, 9510, 9825, 11,820, 11,860, and 12,040 kc.; also on Thursdays at 1230 over 17,870, 15,070, 15,110, and 15,140 kc. *(WPE9DN, G2PE3Y)*

Ethiopia—Addis Ababa has a test xmsn to W. Africa on 15,345 kc. and to W. Europe on 11,875 kc. from 1525 to 1535 s/off. Reports go to *Radio Addis Ababa,* Director of Admissions, P. O. Box 1364, Addis Ababa. *(WPE1TH)*

Falkland Islands—Port Stanley is heard on 3958 kc. from 1922 with pop tunes. They now run to 2015 s/off, all English. *(GP)*

Finland—Helsinki, 15,190 and 17,800 kc., carries Eng. at 0630-0700 Saturdays with a DX program on the first and third Saturday of the month and "Musical Mailbag" on the second and fourth Saturday. "Finlandia Mixture" in Eng. is given on Tuesdays at 0830-0900. *(WPE5AG)*

France—Paris is operating on a new frequency of 11,885 kc. with a native language xmsn closing at 2000. *(WPE9KM)*

Another outlet heard well is on 7240 kc. at 0125-0145 to the S. Central Pacific in French. This is a move from 7280 kc. *(WPEØAE)*

Gabon Republic—*R. Gabon,* Libreville, operates on 4775 kc. at 1230-1700 daily. You might well log this one towards the end of the period. Reports are verified by letter. The address: *Radiodiffusion du Gabon,* B.P. 150, Libreville, Gabon. *(WPEØTA)*

Germany—*Deutsche Welle,* Cologne, is now

using 5980 kc., dual to 9605 kc. at 1900-2030 to Central America in Eng. and Spanish. *(WPE2BRH, WPE9KM, WPEØEW)*

At time of compilation, German lessons for Eng. listeners were being given at 2100-2120 Sundays and Wednesdays. *(WPE1BDB, WPE2BYW, WPE6UD)*

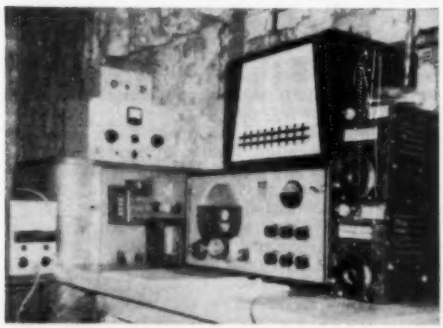
R. Liberty, Munich, operates on 3990 kc. at 2200-1500; on 6055 kc. at 2000-2200; on 7130 kc. at 1900-2100 and 1600-1800; on 7245 kc. at 1700-2300; on 9730 kc. at 1200-0300; on 15,340 kc. at 1700-0000; on 17,730 kc. at 0000-1600; on 17,850 kc. at 0000-0300 and 1200-1700; on 17,865 kc. at 2300-1900. The outlets on 9660, 11,935, 11,965, 15,395, and 15,410 kc. operate 24 hours daily. Reports go to Damenstiftstrasse 5, Munich-2. *(WPE1BM)*

Haiti—4VEH, Cap Haitien, is now on 6120 kc. and is heard from 2200 to 2330s/off; also at 0530 with answers to letters. *(WPE1AAC, WPE1BM, WPE4BC, WPE4HJ, WPE6BOV, WPE6EZ)*

Iceland—TFJ, Reykjavik, was noted on 11,785 kc. with opening at 1456, eight gongs at 1500, and a talk in Icelandic. It is believed that TFJ may now be on 11,780 kc. though this channel is effectively blocked by the BBC. *(WPE1BM)*

Indonesia—Eng. xmsns from *The Voice of Indonesia* are given at 0600-0700 on 11,785 and 9585 kc. to Australia, New Zealand, and Pacific areas; at 0930-1030 on 9585 and 11,795 kc. to S.E. Asia, India, Pakistan, Japan, and Western N.A.; and at 1400-1500 on 11,785 and 9865 kc. to Europe and New Zealand. *(WPE5RB)*

Japan—*R. Japan's* complete new schedule reads: to N.A. at 1930-2030 on 15,135, 17,725, and 21,520 kc.; to N.A. and Hawaii at 0000-0200 on 9525, 11,800, 15,235, and 17,825 kc.; to Europe (I) at 0230-0330 on 15,135. 17,725 and 21,610 kc.; to Europe (II) at 1400-1600 and to the Mid East at 1145-1345 on 9525, 11,800, and 15,135 kc.; to Australia and New Zealand at 0430-0530 on 11,855, 15,235 kc.; to the Philippines and Indonesia at 0630-0700 on 11,855, 15,135, and 17,725 kc. The General Service is broadcast at 1900-1930, 2100-2130, and 2300-2330 on 15,115, 17,785, and 21,610 kc.; at 0100-0200, 0300-0330, 0400-0430, and 0500-0530 on 11,815, 15,105, and 17,785 kc.; at 0600-0630 on



Listening post of Kjell Skollingsberg, WPE7TM, Salt Lake City, Utah, features a Hallicrafters SX-42, Heath Q-Multiplier, and standby RCA receiver. He has 43 countries logged, 37 verified.

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Jordan—A verification from Amman lists the schedule as 2230-0305 on 9530 kc. (100 kw.) and 11,810 kc. (7.5 kw.). *(WPE5AG)*

Malaya—Here is the complete schedule of the BBC Far Eastern Station, Singapore. The asterisked xmsns are relays of the Asian Service of the BBC; the other xmsns are relays of the General Overseas Service of the BBC. Those xmsns followed by (a) close at 1205 Saturdays. To N. & E. China, Hong Kong, Korea and Japan: 0410-0630 on 17,755 kc.; 0415-0430 on 15,435 kc.; 0415-0600 on 11,955 kc.; 0600-0630* on 11,955 kc.; 0630-0845 on 15,435 kc.; and 0700-0745* on 9690, 11,955, and 15,310 kc. To S. China, Vietnam, Laos, and Cambodia: 0410-0630(a) on 9690 and 17,755 kc.; 0415-0430 and 0630-0845 on 15,435 kc.; 0415-0600 on 11,955 kc.; 0630-0700* on 7120 kc.; 0630-0745* on 9690 and 11,955 kc.; 0700-0745* on 15,310 kc., 0800-1150(a) on 9690 kc.; 0800-0815(a) on 9725 and 11,955 kc.; 0845-0915(a) on 9725 kc.; and 0845-1150(a) on 11,955 kc. To Indonesia: 0410-0530 (to 0515 on Sunday, Tuesday and Saturday) on 7120 and 11,820 kc.; 0445-0530 (to 0515 on Sunday, Tuesday and Saturday) on 9725 kc.; 0530-0600* (from 0515 Sunday, Tuesday and Saturday) on 7120, 9725, and 11,820 kc.; 0600-0615 on 7120 and 9725 kc.; and 0600-0630 on 11,820 kc. To Burma and Thailand: 0815-0845 on 9725 and 11,955 kc. To India, Ceylon, and Pakistan: 0800-0845, 1100-1150(a), and 0845-1100* on 11,820 kc.; and 0900-1150(a) on 9690 kc. To Australia: 0800-0815 on 9690 kc. *(WPE5AFU, GP)*

Martinique—Fort-de-France on 2420 kc. is noted with a strong signal airing a Hindi music program around 2040. *(WPE3NF)*

Mexico—A station on 2315 kc., possibly bearing the call XEFSM, has been tuned from before 0000 to 0200 with Mexican music and Spanish anmts. It may be an experimental station for it is not heard daily. *(WPE6EZ, WPEØAE)*

Morocco—The Moroccan Broadcasting System is scheduled as follows. To Southern Morocco (10 kw., Sebaa-Aioun): in Arabic at 0130-0500, 0700-1000 and 1300-1600 on 7115 kc.; in French at 0145-0330, 0730-0900, and 1330-1800, in Spanish at 2030-0400, 0900-1000, and 1800-1900, and in Eng. at 0700-0730 and 1300-1330, all on 7225 kc. To Africa (50 kw., Sebaa-Aioun, except 11,735 kc. which is 50 kw., Tangier): in Arabic at 0130-0500 on 6190 kc., at 0700-1000 on 15,345 and 11,735 kc., and at 1300-1900 on 9505 kc.; in Eng. at 1300-1330, in French at 1330-1530, and in Arabic at 1530-1830, all on 11,735 kc. To the Middle East (100 kw., Tangier): in Arabic (a special program) at 1300-1600 on 9700 kc. Both 9505 & 9700 kc. vary down a few kc. *(WPE1BM)*

Netherlands—The latest schedule from Hilversum reads: Weekdays at 0500-0550 to New Zealand, Australia on 21,480 and 17,775 kc., 0900-0950 to Africa and India on 25,610 and 15,425 kc., 1615-1705 to N.A. and Europe on 6020, 11,730, and 15,220 kc., and 2030-2120 to N.A. on 9590 and 6025 kc.; Sundays at 2100-2230 with "Happy Station Program" on 9590 and 6025 kc. All of these xmsns are in English. *(WPE2BRH, WPE6UD, WPE9AGB, WPE9DN)*

Paraguay—ZPA16, *R. Cultura*, 6210 kc., is a new outlet noted daily around 1900 with music and commercials, all Spanish. Location is Colonelo Viejo. *(GP)*

Peru—OAX7Z, *R. Turiota*, Turiota, 5790 kc., is another new channel heard irregularly at 1500-2100, all Spanish. They claim to be on 6050 kc. with 1 kw. *(GP)*

Portugal—The latest schedule from *Emissora Nacional*, Lisbon, reads: to Eastern N.A. on 11,875 kc. at 1900-2300 (also from 1945 on 9750 kc.); to Western N.A. on 9740 kc. at 2100-2300; to Timor on 21,495 kc at 0500-0800 (also to Macao to 0815); to India, Pakistan, and Persian Gulf areas on 21,495 kc. at 0815-0930 (also from 0845 on 17,880 kc.); to Goa at 0930-1215 on 21,495 kc. (also to 1200 on 17,880 kc.); to British S. & E. Africa at 1215-1300 on 17,895 kc.; to Sao Tome, Angola, and Mozambique at 0500-0815 and 1215-1600 on 21,700 kc., and 1300-1600 on 17,895 kc., and at 1430-1630 on 15,125 kc.; to Portuguese Guinea and Cape Verde Islands at 0500-0800 on 21,700 kc., at 1430-1900

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Anson Boice *(WPE1BD)*, New Britain, Conn.
Robert Anderson *(WPE1BDB)*, New Britain, Conn.
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Matti Takala *(MT)*, Helsinki, Finland
George Henley *(G2PE3Y)*, Watford, England

SHORT-WAVE ABBREVIATIONS

anmt—Announcement
BBC—British Broadcasting Corp.
Eng.—English
ID—Identification
IS—Interval signal
kc.—Kilocycles
kw.—Kilowatts
N.A.—North America
QRM—Station interference
R.—Radio
S/off—Sign-off
S/on—Sign-on
xmsn—Transmission
xmtr—Transmitter

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	0Z4M	.79		4BQ7	.96		6AR5	.55		6CG7	.60		6SA7GT	.76		8EB8	.94		12B4	.83		12EL6	.50		19BG6	1.39
	1AX2	.82		4BS8	.98		6AS5	.60		6CG8	.77		6SK7	.74		100A7	.71		12BA6	.50		12EG6	.54		19T8	.80
	1B3GT	.79		4BU8	.71		6AT6	.43		6CM7	.66		6SL7	.80		11CY7	.75		12BD6	.50		12EZ6	.53		21EX6	1.49
	1DN5	.55		4BZ6	.58		6AT8	.79		6CN7	.65		6SN7	.65		12A4	.60		12BE6	.53		12F5	.66		25BQ6	1.11
	1G3	.73		4BZ7	.96		6AU4	.82		6CR6	.51		6SQ7	.73		12AB5	.55		12BF6	.44		12F8	.66		25C5	.53
	1J3	.73		4CS6	.61		6AU6	.50		6CS6	.57		6T4	.99		12AC6	.49		12BH7	.73		12FM6	.45		25CA5	.59
	1K3	.73		4DE6	.62		6AU7	.61		6CU5	.58		6U8	.78		12AD6	.57		12BL6	.56		12K5	.65		25CD6	1.44
	1L6	1.05		4DK6	.60		6AU8	.87		6CU6	1.08		6V6GT	.54		12AE6	.43		12BQ6	1.06		12SA7M	.86		25CU6	1.11
	1LN5	.58		4DT6	.55		6AV6	.40		6CY5	.70		6W4	.75		12AF3	.73		12BY7	.74		12SK7GT	.74		25DN6	1.42
	1R5	.62		5AM8	.79		6AW8	.89		6CY7	.71		6W6	.69		12AF6	.49		12BZ7	.75		12SN7	.67		25EH5	.55
	1S5	.51		5AN8	.86		6AX4	.65		6DA4	.68		6X4	.39		12AJ6	.46		12C5	.56		12SQ7M	.73		25L6	.57
	1T4	.58		5AQ5	.52		6AX7	.64		6DB5	.69		6X5GT	.53		12AL5	.45		12CA5	.59		12U7	.62		25W4	.68
	1U4	.57		5AT8	.80		6BA6	.49		6DE6	.58		6X8	.77		12AL8	.95		12CN5	.56		12V6GT	.53		25Z6	.66
	1U5	.50		5BK7A	.82		6BC5	.54		6DG6	.59		7AU7	.61		12AQ5	.52		12CR6	.54		12W6	.69		35C5	.51
	1X2B	.82		5BQ7	.97		6BC7	.94		6DQ6	1.10		7A8	.68		12AT6	.43		12CU5	.58		12X4	.38		35L6	.57
	2AF4	.96		5BR8	.79		6BC8	.97		6DT5	.76		7B6	.69		12AT7	.76		12CU6	1.06		17AX4	.67		35W4	.52
	3AL5	.42		5CG8	.76		6BD6	.51		6DT6	.53		7Y4	.69		12AU6	.50		12CX6	.54		17BQ6	1.09		3525GT	.60
	3AU6	.51		5CL8	.76		6BE6	.55		6EU8	.79		8AU8	.93		12AU7	.60		12DB5	.69		17C5	.58		50B5	.60
	3AV6	.41		5EA8	.80		6BF6	.44		6EA8	.79		8AW8	.93		12AV5	.97		12DE8	.75		17CA5	.62		50C5	.53
	3BA6	.51		5EU8	.80		6BG6	1.66		6H6GT	.58		8BQ5	.60		12AV6	.41		12DL8	.85		17D4	.69		50DC4	.37
	3BC5	.54		5J6	.68		6BH6	.65		6J5GT	.51		8CG7	.62		12AV7	.75		12DM7	.67		17DQ6	1.06		50EH5	.55
	3BE6	.52		5T8	.81		6BH8	.87		6J6	.67		8CM7	.68		12AX4	.67		12DQ6	1.04		17L6	.58		50L6	.61
	3BN6	.76		5U4	.60		6BJ6	.62		6K6	.79		8CN7	.97		12AX7	.63		12DS7	.79		17W6	.70		117Z3	.81
	3BU8	.78		5U8	.81		6BK7	.85		6S4	.48		8CX8	.93		12AZ7	.86		12DZ6	.56		19AU4	.83			
	3BY6	.55		5V6	.56		6BL7	1.00																		
	3BZ6	.55		5X8	.78		6BN4	.57																		
	3CB6	.54		5Y3	.46		6BN6	.74																		
	3CF6	.80		6AB4	.46		6BQ5	.65																		
	3CS6	.52		6AC7	.96		6BQ6GT	1.05																		
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	3DK6	.60		6AF4	.97		6BR8	.78																		
	3DT6	.50		6AG5	.65		6BU8	.70																		
	3Q5	.80		6AH6	.99		6BY6	.54																		
	3S4	.61		6AK5	.95		6BZ6	.54																		
	3V4	.58		6AL5	.47		6BZ7	.97																		
	4BC5	.56		6AM8	.78		6C4	.43																		
	4BC8	.96		6AN4	.95		6CB6	.54																		
	4BN6	.75		6AN8	.85		6CD6	1.42																		
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on 17,895 kc., and at 1645-1900 on 15,125 kc.; to the Portuguese Fishing Fleet at 1630-1930 on 11,840 kc.; to Brazil at 0930-1215 on 21,700 kc., at 1630-2045 on 17,895 kc., and at 1645-2100 on 15,125 kc. *(WPE1BM)*

Portuguese India—*Emissora de Goa*, Goa, 17,835 kc., has been heard from 1330 to 1430 in Eng., with news at 1400. This station may only have been testing for it is not heard regularly. *(WPE1AAC, WPE1BM, WPE6EZ)*

South Africa—Paradys has moved from 7295 kc. to 1785 kc., with the former channel now being used for the Afrikaans Service. A new outlet, on 21,525 kc., was noted at 0945-1000; this channel is used from 0930 when 25,800 kc. is closed. The 9560-kc. outlet opens at 0055 with BBC material to 0100, then a formal s/on in English. *(WPE3NF, WPE6EZ)*

Sweden—Stockholm has moved to 11,805 kc., and has news, weather, and a Mailbag program in English to N.A. at 2045-2115. *(WPE1BM, WPE1BY, WPE2BRH)*

Turkey—Ankara on 9515 kc. can usually be heard well at 1815-1900 in Eng. to N.A.; a pop music program is featured on Saturdays. *(WPE5MW, WPE8CCQ)*

Uruguay—CXA60, *R. Sarandi*, Montevideo, 15,385 kc., carries Spanish news at 2000 followed by South American dance music. *(WPE8UM)*

Vatican City—*Vatican Radio* has been noted from 1930 to S. America on 11,740 kc.; this may be a permanent move from 11,685 kc. *(WPE9KM)*

Yugoslavia—*R. Belgrade* has moved an outlet into the 25-meter band where it is noted from 2000 s/on in Spanish on 11,885 kc. S/off at 2030. *(WPE9KM)*

Unidentified—A station, believed to be Cuban, has been noted on 15,176 kc. (Sunday only) with pro-Castro speeches and ID of *Radio Emisoras Independientes y Libres* and, at times, *Universidad Popular*. They s/off promptly at 1440. *(SH)* —30—

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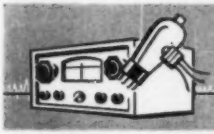
Voices from Europe

(*Continued from page* 46)

Most short-wave broadcasting stations use a number of transmitters on different frequencies at the same time. Generally, these are in different bands and provide the listener with an option so that he can capture the clearest signal. During the evenings, European stations are heard with strong signals in the 9- and 11-megacycle bands (31 and 25 meters). When receiving conditions are disturbed, look for stations in the 6- and 7-mc. bands (49 and 41 meters). In the early morning hours you can generally hear strong signals around 21 and 25 mc. (15 and 13 meters). The 15- and 17-mc. bands (19 and 16 meters) are used mostly in the late afternoons and early evenings. —30—



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WANT to buy good equipment and accessories? Place a low-cost classified ad in this space. For information, write: Martin Lincoln, Popular Electronics, One Park Avenue, New York 16. N. Y.

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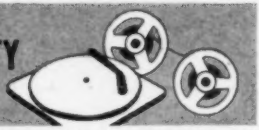

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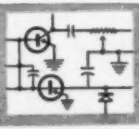

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COIN operated bowling machines, putt type, original cost up to $900.00 in good working order. Can easily be converted for use without coins for home playroom, or can be operated on locations as profitable money maker. $165.00 F.O.B. Sorry, No C.O.D. at this low price. Mahonik Amusement, Dept. 4, 280 West Eighth Street, Oswego, N. Y.

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FOR REPAIRING ALL ELECTRICAL APPLIANCES and AUTOMOBILE CIRCUITS

Model 70—UTILITY TESTER
Total Price . . . $15.85—
Terms: $3.85 after 10 day trial, then $4.00 monthly for 3 months, if satisfactory. Otherwise return, no explanation necessary.

As an electrical trouble shooter the Model 70:

- Will test Toasters, Irons, Broilers, Heating Pads, Clocks, Fans, Vacuum Cleaners, Refrigerators, Lamps, Fluorescents, Switches, Thermostats, etc.
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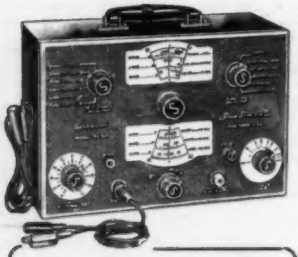
Model 70 comes complete with 64 page book and test leads

Only **$15.85**

Superior's New Model TV-50A **GENOMETER**

7 Signal Generators in One!



Model TV-50A GENOMETER. . .
Total Price. $47.50
Terms: $11.50 after 10 day trial, then $6.00 monthly for 6 months if satisfactory. Otherwise return, no explanation necessary.

√ *R.F. Signal Generator for A.M.* √ *Bar Generator* √ *Marker Generator*
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This versatile All-Inclusive GENERATOR Provides ALL the Outputs for Servicing:
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R. F. SIGNAL GENERATOR: The Model TV-50A Genometer provides complete coverage for A.M. and F.M. alignment. Generates Radio Frequencies from 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics.

VARIABLE AUDIO FREQUENCY GENERATOR: In addition to a fixed 400 cycle sine-wave audio, the Model TV-50A Genometer provides a variable 300 cycle to 20,000 cycle peaked wave audio signal.

MARKER GENERATOR: The Model TV-50A includes all the most frequently needed marker points. The following markers are provided: 189 Kc., 264.5 Kc., 456 Kc., 600 Kc., 1000 Kc., 1400 Kc., 1600 Kc., 2000 Kc., 2500 Kc., 3579 Kc., 4.5 Mc., 5 Mc., 10.7 Mc., (3579 Kc. is the color burst frequency).

CROSS HATCH GENERATOR: The Model TV-50A Genometer will project a cross-hatch pattern on any TV picture tube. The pattern will consist of non-shifting, horizontal and vertical lines interlaced to provide a stable cross-hatch effect.

BAR GENERATOR: The Model TV-50A projects an actual Bar Pattern on any TV Receiver Screen. Patterns will consist of 4 to 16 horizontal bars or 7 to 20 vertical bars.

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Superior's New Model 77

VACUUM TUB

WITH NEW 6" FULL-V.

Compare it to any peak-to-peak V. T. V. M. made by any othe

- Extra large meter scale enables us to print all calibrations in large easy-to-read type.
- Employs a 12AU7 as D. C. amplifier and two 90O6's as peak-to-peak voltage rectifiers to assure maximum stability. • Meter is virtually burn-out proof. The sensitive 400 micro-ampere meter is ... measuring circuit by a balancen ... amplifier. • Uses selected 1% zero temp... ture coefficient resistors as multipliers. This assures unchanging accurate readings on all ranges.

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AS AN ELECTRONIC OHMMETER: Because of its wide range of measurement leaky capacitors show up glaringly. Because of its sensitivity and low loading, Intermittents are easily found, isolated and repaired.

AS AN AC VOLTMETER: Measures RMS values if sine wave, and peak-to-peak value if complex wave. Pedestal voltages that determine the "black" level in TV receivers are easily read.

SPECIFICATIONS

• **DC VOLTS**—0 to 3/15/75/150/300/750/1,500 volts at 11 megohms input resistance. • **AC VOLTS (RMS)**—0 to 3/15/75/150/300/750/1,500 volts. • **AC VOLTS (Peak to Peak)**—0 to 8/40/200/400/800/2,000 volts. • **ELECTRONIC OHMMETER**—0 to 1,000 ohms/10,000 ohms/100,000 ohms/1 megohm/10 megohms/100 megohms/1,000 megohms. • **DECIBELS:** −10 db to + 18 db, + 10 db to + 38 db, + 30 db to + 58 db. All based on 0 db = .006 watts (6 mw) into a 500 ohm line (1.73v). • **ZERO CENTER METER**—For discriminator alignment with full scale range of 0 to 1.5/7.5/37.5/75/150/375/750 volts at 11 megohms input resistance.

Comes complete with operating instructions, probe leads, and streamlined carrying case. Operates on 110-120 volt 60 cycle. Only $42.50

SUPERIOR'S NEW MODEL 79

SUPER-METER

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A Combination **VOLT-OHM MILLIAMMETER**

Plus **CAPACITY, REACTANCE, INDUCTANCE & DECIBEL MEASUREMENTS**

Also Tests **SELENIUM & SILICON RECTIFIERS, SILICON & GERMANIUM DIODES**

The model 79 represents 20 years of continuous experience in the design and production of SUPER-METERS, an exclusive SICO development. It includes not only every circuit improvement perfected in 20 years of specialization but, in addition includes those services which are "musts" for properly servicing the ever-increasing number of new components used in all phases of today's electronic products. For example with the Model 79 SUPER-METER you can measure the quality of selenium and silicon rectifiers and all types of diodes — components which have come into common use only within the past five years, and because this latest SUPER-METER necessarily required extra meter scale, SICO used its new full-view 6-inch meter.

SPECIFICATIONS:

● **D.C. VOLTS:** 0 to 7.5/15/75/150/750/1,500. ● **A.C. VOLTS:** 0 to 15/30/150/300/1,500/3,000 ● **D.C. CURRENT:** 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes ● **RESISTANCE:** 0 to 1,000/100,000 Ohms, 0 to 10 Megohms. ● **CAPACITY:** .001 to 1 Mfd., 1 to 50 Mfd. ● **REACTANCE:** 50 to 2,500 Ohms, 2,500 Ohms to 2.5 Megohms. ● **INDUCTANCE:** .15 to 7 Henries, 7 to 7,000 Henries. ● **DECIBELS:** −8 to +18, +14 to +38, +34 to +58. The following components are all tested for QUALITY at appropriate test potentials. Two separate BAD-GOOD scales on the meter are used for direct readings. All **Electrolytic Condensers** from 1 MFD to 1000 MFD. **All Germanium Diodes. All Selenium Rectifiers. All Silicon Diodes. All Silicon Rectifiers.**

Model 79 comes complete with operating instructions, test leads, and streamlined carrying case. Use it on the bench—use it on calls. Only $38.50

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Dept. D-833 3849 Tenth Ave., New York 34, N. Y.

Please send me the units checked on approval. If completely satisfied I will pay on the terms specified with no interest or finance charges added. Otherwise, I will return after a 10 day trial positively cancelling all further obligation.

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$3.85 within 10 days. Balance $4.00 monthly for 3 months.

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$8.50 within 10 days. Balance $6.00 monthly for 5 months.

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All prices net, F.O.B., N. Y. C.

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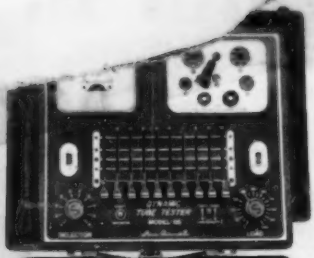
Superior's New Model 85—*a DYNAMIC type* **TRANS-CONDUCTANCE**

TUBE TESTER



Model 85—Trans-Conductance Tube Tester. Total Price—$52.50.
Terms: $12.50 after 10 day trial, then $8.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary.

● Employs latest improved **TRANS-CONDUCTANCE** circuit. Tests tubes under "dynamic" (simula operating conditions. An in-phase signal is impressed on the input section of a tube and the resultant p current change is measured as a function of tube quality. This provides the most suitable method of simu ing the manner in which tubes actually operate in radio, TV receivers, amplifiers and other circuits. plification factor, plate resistance and cathode emission are all correlated in one meter reading.

● **SYMBOL REFERENCES:** For the first time ever in a trans-conductance tube tester, Model 85 employs time-saving symbols (★, ✦, ●, ▲, ■) in place of difficult-to-remember letters previously used. Repeated time studies proved to us that use of these scientifically selected symbols speeded up the element switching step. As the tube manufacturers increase the release of new tube types, this time-saving feature becomes more necessary and advantageous.

● **THE "FREE-POINT" LEVER TYPE ELEMENT SWITCH ASSEMBLY** marked according to RETMA basing, permits application of test voltages to any of the elements of a tube. The addition of an extra switch position permits the application of the necessary grid voltage needed for dynamic testing and insures against possible obsolescence due to changes in basing design.

● **NEW IMPROVED TYPE METER** with *sealed air-damping chamber* provides accurate, *vibrationless* readings.

● **FREE FIVE (5) YEAR CHART DATA SERV** The chart provided with Model 85 includes easy read listings for *over 1,000 modern* tube types vised up-to-date subsequent charts will be maile all Model 85 purchasers *at no charge* for a pe of five years after date of purchase.

● **SPRING RETURN SAFETY SWITCH** pr Model 85 against burn-out if tube under te "shorted."

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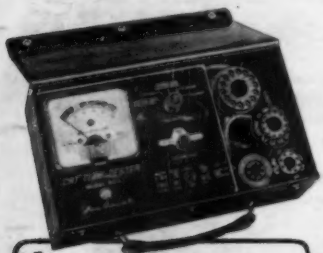

Model 83—C.R.T. Tube Tester
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